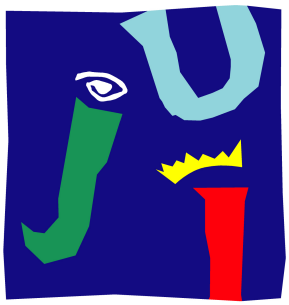

UNIVERSITAT JAUME·I

# CIRCULAR ECONOMY IN THE SPANISH FOOD AND BEVERAGE SECTOR: ANALYSIS OF THE PRESENT SITUATION

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# INDEX

## A. INDEX OF TABLES



## B. INDEX OF ILLUSTRATIONS

## 1. INTRODUCTION

The world faces a serious environmental problem in which the finite natural resources are being depleted. The present economic model, the linear model of production, has dominated the global economy evolution. The “make-take-waste” linear economy is not sustainable because it relies on huge quantities of cheap raw materials and energy easily accessible in order to manufacture products and then, these products are discarded as waste. Moreover, in the processes of extracting natural resources some residues are generated and they are eliminated by incineration, destruction or they are deposited in landfills instead of reintroducing them in the production system. Therefore, the linear economy model is not sustainable. Several policies have been established to improve resource efficiency although the rapid acceleration of consumptive economies has led to a significant increase of the negative impact on the environment. Moreover, the linear economic model has been at the heart of industrial development. However, nowadays there is a need to rethink the materials and energy used since linear consumption is reaching its limits.

The circular economy is an alternative to the widely expanded linear economy since the circular economy model is aimed at decoupling global economic development from limited natural resources (Ellen Macarthur Foundation, 2012). Moreover, the circular economy could generate economic growth and diminish environmental impacts since it is considered a restorative industrial system both by intention and design (Stahel, 2016). In addition, the circular economy guarantees the sustainability of natural resources.

Business leaders and policymakers are focusing on the transition to a circular economy since it is one of the top policy priorities in the European Union. That is, companies and official institutions are exploring ways to give products another life so as to reduce the raw materials employed to manufacture a new product. Innovation plays a key role in the transition towards a sustainable economy because leading-edge technologies, processes, efficient services and new business models will be needed. The change towards this new economic model also requires the educational system cooperation so as to promote awareness, the responsible use of resources, and the generation of new professional profiles.

This social and economic model based on the principles of the circular economy, undoubtedly constitutes the best way to correct part of the errors and aggressions committed in the past in relation to the planet's resources. In addition, it is the most advisable preventive way to avoid a negative environmental impact.

This present paper aims to carry out an analysis of the situation in Spain in relation to the implementation of this new economic perspective. More specifically, this research will focus on the analysis of the different sub-sectors within the food and beverage sector (meat sector, fisheries processing sector, dairy sector, bread and milling sector and beverage sector), since it is one of the most important sectors in our country. Through this analysis, it is intended to make a diagnosis of how the Spanish food and beverage sector is evolving and adapting to a more sustainable environment with a more environmentally friendly production model.

In conclusion, this academic work will consist of an analysis of the current situation regarding the circular economy transition of the main sub-sectors within the food and beverage sector in Spain. Moreover, the main line of actions that are being carried out in relation to the circular economy will be explained and analysed. To achieve this objective, the main strategies implemented by the different sub-sectors to reverse the current situation will be identified and described. Finally, five case studies which are successful and representative companies will be examined regarding the practices conducted and the market power. In this way, the case studies may serve as a reference for other companies which want to establish this economic model within this important sector in the Spanish economy.

## 2. THEORETICAL FRAMEWORK

In this chapter we will introduce the concept and implications of the circular economy from a theoretical perspective. Firstly, we are going to describe the circular economy model through the analysis of the concept itself, their objectives and barriers. Once the model is introduced, the main strategies pursued by the circular economy will be described in detail and finally, the new business models arising from the circular economy will be examined.

### 2.1. The Circular Economy Model

In this section, the concept of circular economy as well as its main objectives and barriers will be fully described and analysed.

#### 2.1.1. The Concept of Circular Economy

The concept of circular economy dates back to the end of the 1970s developed by several schools of thought and authors such as Kenneth Boulding (UK, 1910-1993) who wrote an essay entitled *The Earth Spaceship Economy (*Boulding, (1966). The economic activity in the current world economy is based mainly on extracting resources and raw materials from nature in order to process and transform them into products for the markets. Later, these manufactured products are destined for human consumption and then, they are disposed of for different reasons such as obsolescence or, aesthetic criteria among others.

Today, resources and raw materials are being depleted and the planet's pollution is reaching unsustainable limits. The word population in continuous exponential growth and the increase in the needs of developing populations, as well as the maintenance of well-being and consumption of developed populations, prevents biological systems from restoring their balance, breaking natural cycles. (Ellen McArthur Foundation, 2012).

Opposite to this situation, the circular economy is a new regenerative system designed to maintain the value of products and material resources such as water, soil and energy, limiting the extraction of raw materials. Moreover, the circular economy avoids the generation of waste and reduces the negative impact on the environment. The aim is to approach the life cycle of the product from an “industrial ecology” perspective in order to bring benefits to society and reduce our impact on the environment. In fact, a new economic

paradigm different from the one adopted 50 years ago in our society has been implemented. The linear economy is based on operating under a system in which everything manufactured has an end and hence, it leaves the production cycle. It begins by consuming raw materials and then, the materials are processed and converted into a product, which is generally a single-use product or has a really short life. The cycle that elapses from when the product is manufactured until it is discarded is characterised by being brief and extremely short (Ellen McArthur Foundation, 2015).

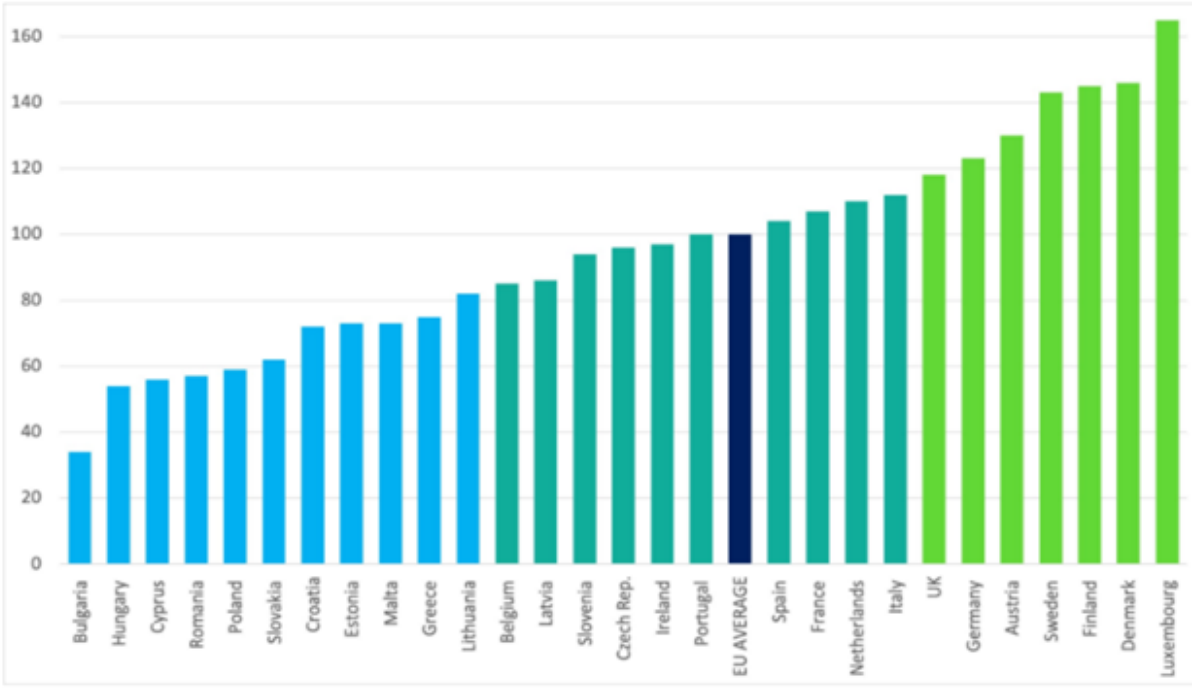
The foundations of the circular economy paradigm are the three Rs which correspond to reduce, reuse and recycle. Moreover, the manufacturing processes and the use of materials follow the same objective of consuming the minimum amount of energy and eliminating, as far as possible, the generation of waste that negatively impacts the environment. For these reasons, the circular economy closes the life cycle of products through the production of goods and services from the waste generated in other production processes.

The circular economy is ceasing to be an abstract concept since it is acquiring more and more prominence. This new economic model is becoming a benchmark of the great changes and transitions that current models and lifestyles need. The actual model implies high pressure on resources, degradation of ecosystems and the loss of natural capital. Therefore, there is a need to develop new patterns that guarantee a sustainable future, substantially transforming our ways of producing, consuming and living.

In recent years the circular economy has received increasing attention among scientists, policy makers, business sectors and organisations around the world. In fact, in the European Union (EU), this economic paradigm has become a priority. The actions proposed by the EU in the area of circular economy since the middle of this decade are penetrating the productive systems and the behaviour of citizens. The aim is to bring considerable benefits to the environment, the economy and the health of the people of the member countries (Comision Europea, 2020).

In the following graph, it can be seen the eco-innovation ranking of the countries' members of the European Union. Spain is in the eleventh position in the ranking, exceeding the average of the European countries by 4 points, which is 100 points. Luxembourg is the country which has the first position and Bulgaria has the last one.

**Illustration 1, Eco-innovation Scoreboard ranking and eco-innovation index composites for Spain in 2019**




***Source: Ec Europa, 2019***

In the case of Spain, after the presentation by the European Commission in December 2015 of the *EU Action Plan for the Circular Economy*, and the successive initiatives developed in 2017 and 2018, the circular economy actions have been intensified in recent years. Most actions have been conducted by administrations in the field of circularity, as well as by business sectors, institutions and civil society. This reflects how over the years the circular economy will have a greater impact on all aspects of our daily lives. A vital aspect so as to reverse the current situation is to encourage a change or a reconsideration in the consumer behaviour to move towards a more sustainable model based on the performance and durability of the products (Comisión Europea, 2020).

### 2.1.2. Objectives of the Circular Economy

The circular economy is based on a series of objectives which are the following ones (Responsabilidad Social, 2018):

- Protect the environment in order to guarantee people's health by reducing the use of natural resources which are not renewable and encourage the reuse of both primary and secondary waste generated within the production cycle.

- Foster the analysis of the products' life cycle and the incorporation of eco-design criteria to reduce as much as possible the introduction of harmful substances in the manufacturing process. In this way, the repairability of goods that have already been produced is facilitated, prolonging their useful life and making it possible to evaluate them at the end of the process.

- Promote a responsible consumption model, based on the transparency of information characteristics of goods and services such as their duration and energy efficiency, through the use of measures such as the use of the eco-label.

- Facilitate and promote the creation of appropriate channels to facilitate the exchange of information and coordination with public administrations, the scientific and technological community, and economic and social agents for the purpose of creating synergies that favour the transition.

- Generate new sources of employment and facilitate their development. The circular economy fosters the generation of new jobs, and the development of this model means obtaining a competitive advantage in the current globalised economic context.

For this reason, if the circular economy is correctly exploited, it can be an aspect that contributes to economic viability.

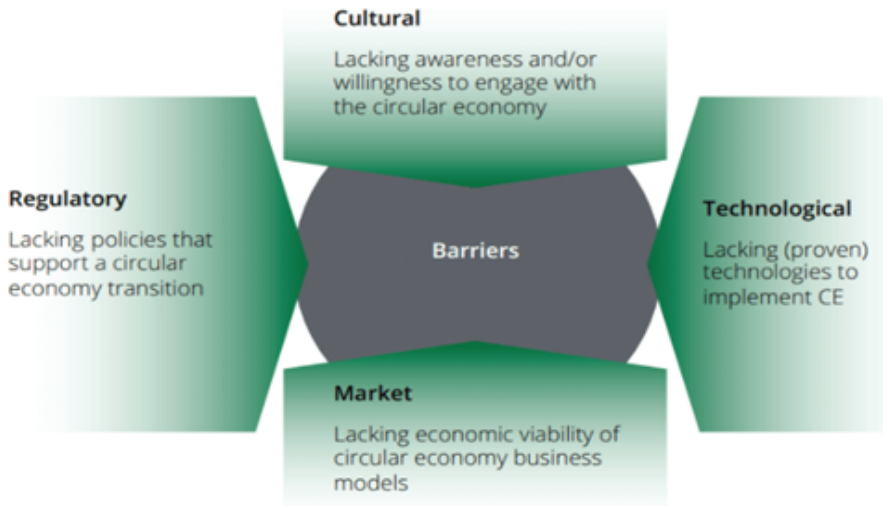
### 2.1.2. Barriers to the Circular Economy Model

It is often argued that the circular economy has two weaknesses which are the lack of financing and that new technologies are not prepared to be adapted to the circular economy. However, according to Gonzalo Delacámara, consultant for international institutions such as the World Bank, the European Commission, the United Nations and the OECD, the vulnerability of this model is "false, since the organisations know that there is no shortage problem but there is a governance crisis" (Delacámara, 2020). Moreover, Delacámara states that one of the main problems of the circular economy is that the popularisation of this economic model is failing. This is known as the Jevons paradox introduced by the economist William Stanley Jevons, who argues that as the efficiency and technologies become more improved, their use becomes more attractive which leads to an increase in global

consumption. Another aspect that Delacámara emphasised is people need to "be able to live off our waste in order to continue living off our resources" (Delacámara, 2020).

In the following table the main barriers of the circular economy are shown. The barriers can be classified into four groups: political and regulatory barriers, cultural acceptance barriers, technological and infrastructure barriers, and access to financing and economic barriers (Execyl, 2017).

**Illustration 2, Types of circular economy Barriers**




***Source: Van Ejik, (2015)***

At the political and regulatory level, a large part of government entities points out that they are working on the adoption of circular economy models although more support is needed. According to the report *Paving the way for a circular economy: insights on the status and possibilities*, carried out by the European Environment Agency (EEA), countries employ regulations only for recycling, energy recovery and waste management. However, everything related to eco-design, consumption and reuse has less severe policies. Thereby, it is precisely necessary a greater coordination of the different standards that currently exist to undertake the change through the governments' support and encouragement (through effective tax policies, training, possibility of financing among others) (AEMA, 2020).

At the level of cultural acceptance, the second major impediment is found in the consumers since they are used to the throwaway model. The main problem within this barrier is the lack of knowledge and misinformation about the circular economy by consumers. For this reason, consumers must change their habits based on the model of recycling and reusing products, paying for use instead of ownership and they must understand that a reused product can have the same quality as a new manufactured product. In addition, the products'

consumption model with planned obsolescence is a great handicap for customers so as to opt for products with a longer life cycle or which are easy to repair and continue being used.

At the technological level, the main problem is the lack of adequate technological mechanisms. According to the aforementioned EEA report, monitoring the progress of the circular economy implementation requires greater investment, especially to obtain relevant data both in the production and consumption phases (the two life cycles of each product). For this reason, specialists need both technical skills, as well as the appropriate technological elements to carry out their work.

Thus, all barriers are related and are derived from the authorities, which are the ones that must seriously consider an economic model bringing positive aspects. In order to achieve the total implementation of the circular model, authorities and policymakers must establish effective policies, they must raise the population's awareness and must invest to create a more sustainable future.

At the level of funding, the main problem is the high cost of new innovation and green business models for the adoption of sustainable practices for SMEs. The initial costs of such investments and the expected amortisation period are particularly important for these companies. Generally, SMEs are more sensitive to the additional financial costs resulting from green business activities compared to large companies.

In addition to the improvements in the current public funding, alternative financing models are needed. These new financing models need to take into account the companies most committed to transparency, reporting of activities and corporate social responsibility both at an economic and social and environmental level. Likewise, the elimination of value added taxes (or reduced tax) on those products that have been recycled would also boost their consumption.

To overcome these barriers, education plays a key role so as to raise new generations' awareness. According to Freek van Eijk, director of *Acceleratio*, a Dutch consulting firm dedicated to advising towards the growth of the circular economy: "this transition period can last one or two generations." (Van Ejik, 2015)

The University of Cambridge offers a set of tools called the *Circular Economy Toolkit* through which companies that want to implement the circular economy model can gradually introduce concepts related to this economic system and how to adopt it.

## 2.2. Strategies and new business model regarding Circular Economy

In this section, the concept of circular economy will be analysed in depth, more specifically, the main strategies adopted at both national and European level. In addition, the new business models created thanks to this new economic paradigm will be explored.

### 2.2.1. Strategies of the Circular Economy

In order to accelerate the implementation of the circular economy a number of strategies are explained in detail. These strategies are aimed at promoting the use of recycled materials, fostering reuse and repair as well as decoupling economic activity from the consumption of finite resources. These strategies are extremely necessary to reduce the negative impact on the environment (Martín, 2020). In this section, the main strategies are described:

**1. Circular economy through sustainable production and product design.**

This strategy is carried out through a series of objectives which are:

• Promote clear and accessible information regarding the content, origin and environmental impact of products and how they can be recycled.

• Move towards a situation where products are designed to have a long useful life, facilitating their reuse and repair, and allowing recycling when they can no longer be used.

• Promote a greater use of non-toxic recycled materials when manufacturing new products. In order to achieve this objective, it could be introduced the requirement of including a certain amount of recycled material in the product.

• Develop long-term economic instruments under the premise of *polluter pays*, so that the cost of materials and products also includes the cost of their environmental and climatic impact.

• Stimulate the development of more efficient production processes in terms of resources and energy. Moreover, promote the development of standards supporting the design of competent products in terms of resources, circularity and non-toxic.

**2. Circular economy through sustainable forms of consumption and use of materials, products and services.**

In order to achieve this strategy, the following measures must be implemented:

• Improve consumer information to facilitate sustainable and circular decision-making in their daily life.

• Examine how to promote the creation of new circular business models aimed at increasing the life, reuse and reparability of products, taking into account the interests of consumers and their real needs.

• Create the optimum conditions for a greater supply and demand of services in order to be reused and repaired, making it profitable for business operators and individuals.

• Contribute to resource efficiency, recycling, and circular business models through public procurement.

**3.Circular economy through non-toxic and circular material cycles.**

The following measures are needed to achieve the implementation of the strategy:

• Promote reusing products before recycling them.

• Move towards a situation where fossil raw materials are replaced by renewable and bio-based raw materials since they do not have any negative impact on biodiversity or on other ecosystem services.

• Develop the classification of waste so that the largest amount of residues can be recycled.

• Facilitating the separation of residues so as to make recycling easier for the population, businesses and services.

• Move towards a situation where waste is managed in circular cycles in which supply, demand and the use of high-quality reused raw materials is increased.

• Ban the use of highly polluting substances, as well as some other substances and chemicals that can cause serious damage to human health and the environment.

• Establish high and equivalent requirements for virgin non-toxic and recycled materials.

**4. The circular economy as a driving force for the business sector and other agents through measures to promote innovation and circular business models.**

In order to carry out this strategy, the following measures must be adopted:

• Design political instruments that contribute to profitable circular business models in order to provide facilities to companies and contribute to their development.

• Design of political instruments that contribute to increasing the supply and demand for circular products and services.

• Promote research, innovation and technological development in areas such as recycling, digitisation and traceability to facilitate circular business models and a more efficient and circular use of society's resources.

All these strategies are necessary and closely bound to the creation of new value chains within the perspective of the circular economy. For this reason, a large number of business opportunities can be generated after the implementation of this economic model.

### 2.2.2. New European Strategy towards Circular Economy

Over the years, countries are increasingly adopting measures related to the circular economy. In order to achieve a transition to this economic paradigm, organisations and companies are implementing new environmental policies. In a European context last January, the foundations of the new circular economy action plan were established at the European level, with guidelines set by the European Association for Waste Management (FEAD). This plan was carried out by Peter Kurth, president of FEAD and Christoph Epping, German Minister of the Environment, and Jan Huitema, European MEP rapporteur of the Action Plan for the Economy Circular. In this assembly, MEPs agreed that the European Union needs clear objectives to achieve a fully circular, toxic-free and carbon-free economy by the year 2050 (Retema, 2021).

As Jan Huitema points out, "Europe is not a continent rich in resources, but we have the skills, experience and capacity to innovate and develop the necessary technologies to close ties and build a waste-free society." In this sense, products should be designed in a way that reduces waste, avoids harmful substances and pollution, in addition to protecting human health (El Global, 2021).

In order to attain this goal, European representatives have pressured the Commission to introduce harmonised, comparable and uniform circularity indicators for material and consumption footprints. In this regard, MEPs demand the adoption of target objectives based on science, the use of materials and the consumption footprint by 2030 (Gaceta Médica, 2021).

The setting of the new objectives when preparing the action plan are grounded on four key issues which are the following ones (Retema, 2021):

- Europe cannot achieve its circularity targets without creating a truly competitive market for secondary raw materials. Achieving these goals requires adequate financial incentives and harsh environmental measures, such as including recycled materials in products.

- The product design stage is an important aspect since eco-design measures are essential to increase the recyclability and reuse of products.

- In order to avoid greenhouse gas emissions, waste that can be recycled or recovered must not end up in landfills.

-Transforming non-recyclable waste into energy is a crucial part of the circular economy, so energy recovery from waste is now more necessary than ever.

These should be the foundations both for the fulfilment of the objectives already established by the institutions, as well as the foundations for elaborating the new circular objectives.

### 2.2.3. New Business Models for the Circular Economy

The circular economy has become a great source of inspiration not only for already established companies, which are adopting management strategies towards this new economic paradigm, but also for many entrepreneurs and small companies, which are considering where to focus their new projects and businesses. This innovative model based on circularity has led to a large number of opportunities and new market niches ready to be explored. For this reason, in recent years new circular business models have emerged. According to Pérez, (2019), they can be divided into 5 groups: circular supplies, resource recovery, product life extension, platform sharing, and product as a service. Now, these five big groups will be described:

### 1- Circular supplies

The circular supplies business model is based on the supply of fully renewable, recyclable or biodegradable resources for circular production and consumption systems. Companies can use this model to replace increasingly scarce linear resources, while reducing waste and eliminating inefficiencies. It is especially suitable for companies that use scarce raw materials or have a large environmental footprint (Pérez, 2019).

An example of this business model would be the Spanish company *Nostoc Biotech*, the main purpose of this company is to transform traditional agriculture into more sustainable agriculture. Traditional agriculture overloaded with chemicals, is transformed in this case into natural fertilisation and protection solutions for all crops.

The production of fertilisers is carried out by protecting certain decomposing microorganisms that are essential to protect plants and trees from other diseases. Its ecological products improve the health of the soil and plants, providing complete nutrition for our garden, orchard and vegetable garden (Social Enterprise, 2019).

### 2- Recovery of resources

Resource recovery aims to divert useful wastes away from landfill in order to use them to create valuable new products. In other words, it allows waste to be transformed into value through innovative recycling and recovery services. Based on traditional recycling markets, this business model employs new technologies to recover almost any type of product into its initial value. The main solutions range from industrial symbiosis to integrated recycling in closed cycles or Cradle to Cradle designs, which allow processing products into new ones.

The recovery of sources model allows a company to eliminate material losses and maximise the economic value of product flows. It is suitable for companies that produce large volumes of waste or that can recover and reprocess waste in a cost-effective manner.

A representative example would be the Mallorcan company *Camper*, which manufactures high-end shoes with waste. At least one part of their emblematic model 'Pelotas' is already made with plastic from industrial waste, bottles and scraps. Currently, it is a small project, but it has an enormous potential to change the culture of the fashion industry which is highly connected to the culture of throwaway (Galián, 2019).

**3- Extension of the useful life of the product**

This business model allows companies to extend the life cycle of their products and assets. Through product repair, upgrade, remanufacturing, or remarketing, it is possible to maintain or even increase the product's value that would otherwise be disposed of.

A company can use this model to keep the economic value of the products the highest amount of time possible. In addition, products are updated in a more accurate way, for instance, by replacing an outdated component instead of the entire product.

This model is appropriate for most of the business to business (B2B) segments that require large investments (such as industrial equipment), as well as for the business to consumer (B2C) companies which offer customers new improved versions of a product regarding the previous version.

An example that reflects this model would be the Madrid company *Desguaces La Torre*. Scrapyards have become 'markets' or 'shops', where you can buy second-hand vehicles parts that are in perfect condition and that provide the maximum guarantees of functionality and safety to drivers. Each of the spare parts that are put up for sale undergo strict security controls to verify their good condition. For this reason, it is possible to extend the useful life of vehicle parts that alternatively, would be disposed of in containers.

**4- Platform sharing**

The platform sharing business model encourages collaboration between product users, whether they are individuals or organisations. In this way, it is possible to compensate for excess capacity or lack of use, increasing productivity and the value that is provided to users.

This model, which helps to maximise levels of use, could be beneficial for companies whose products and assets have a low level of use or ownership. However, at present it is more common to find this model in companies specialised in increasing the level of use of products without the company carrying out any production work, which puts considerable pressure on traditional producers.

An example would be Wallapop, a Spanish mobile application that allows buying and selling second-hand items with the advantage of geolocation. In other words, it enables users to search and offer products. Therefore, it is a platform that allows extending the life of those products that are no longer being used (De Oteiza, 2019).

**5- Product as a service**

The product as a service business model offers an alternative to the traditional “buy and own” model. In this case, one or more customers use the products under a rental or pay-per-use contract. This business model completely transforms the incentives to make products more durable and easy to upgrade, with an emphasis on obtaining high-performances. In a product as a service business model, longevity and reusability of a product are seen as aspects that can increase incomes and reduce costs.

This model can be attractive to companies whose products have a high cost of ownership and may have high value for their customers to manage product maintenance.

An example of this model would be Arval, a Spanish company with an international presence, dedicated to renting full-service vehicles. The car is property of the tenant company although it is rented. The individual rents the product or service for a specific time that is stipulated in the contract (and which usually ranges between two and five years) by paying a certain monthly fee. This includes the expenses derived from the use of the vehicle such as taxes, maintenance, possible breakdowns, insurance or tires among others (these are usually extended depending on the type of plan that is contracted). Hence, the person or company renting the car only has to pay the cost of gasoline, tolls and fines (Gutiérrez, 2021).

**Table 1, New Business Models for the Circular Economy**

| BUSINESS MODEL | DEFINITION | EXAMPLES |
|---|---|---|
| **Circular supplies** | It is based on the supply of fully renewable, recyclable or biodegradable resources for circular production and consumption systems | ***Nostoch Biotech*:** transform traditional agriculture into more sustainable agriculture |
| **Recovery of resources** | It recovers value from end-of-life materials and products | ***Camper*:** manufactures high-end shoes with waste |
| **Extension of the useful life of the product** | It extends the life cycle of the products through the repair, upgrade | ***Desguace La Torre*:** they sell second-hand vehicle parts |
| **Platform sharing** | It encourages collaboration between product users and it compensates for excess capacity or lack of use | ***Wallapop*:** mobile application that allows buying and selling second-hand items |
| **Product as a service** | Products are used under a rental or pay-per-use contract. | ***Arval*:** renting full-service vehicles |

***Source: Own elaboration, from Anna Pérez, (2019)***

# 3. METHODOLOGY AND CONTEXT OF THE RESEARCH

## 3.1. Research Design

Case study methodology is the research method used in this paper. Conducting a case study research means studying the research's subject within its social, political, organisational and economic context. Moreover, case study is one of the most common approaches present in the social and management sciences (Yin, 2009).

According to Yin (2009), case study research is defined as "... an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2009, p. 638). That is to say, the research's subject is thoroughly examined as a representative example of a real life phenomenon within its real context. Dul and Hak claim that "A case study is a study in which a) one case (single case study) or a small number of cases (comparative case study) in their real-life context are selected, and b) scores obtained from these cases are analysed in a qualitative manner" (Yin, 2006, p. 4).

Thanks to case study it can be revealed how and the reasons why some phenomena happen and the process by which causal relationships occur (Fondevila & del Olmo Arriaga, 2013). One of the researchers' tasks is to collect detailed data making use of several data collection tools and procedures over a certain period of time (Yin, 2009). The data analysed can be both qualitative and quantitative so that it can be examined from different perspectives. A case study provides the researcher with meaningful information about the subject of the study and it analyses the factors which lead to the subject's behaviour. Moreover, a large number of data is needed to reach conclusions.

As stated by Yin (1989), a case study can be divided into several categories which are namely exploratory, descriptive and explanatory studies. In this paper, the conducted research is descriptive, since it describes a phenomenon, in this case, the situation of the new economic model, the circular economy, and the real context corresponding to the food and beverage sector in Spain.

In relation to the source of data used to conduct the research, it is worth mentioning that the information has been extracted from secondary sources. The information included is taken from websites, international journals, articles, reports and official documents elaborated by well-known institutions.

It is worth mentioning The Ministry of Agriculture, Fisheries and Food of the Government of Spain and the National Institute of Statistics so as to obtain more concrete information and figures related to the circular economy and to the food and beverage sector. In addition, websites such as Eco-circular and Ellen Macarthur Foundation and news portals related to the circular economy have been very useful to obtain recent and updated information.

## 3.2. Research Context

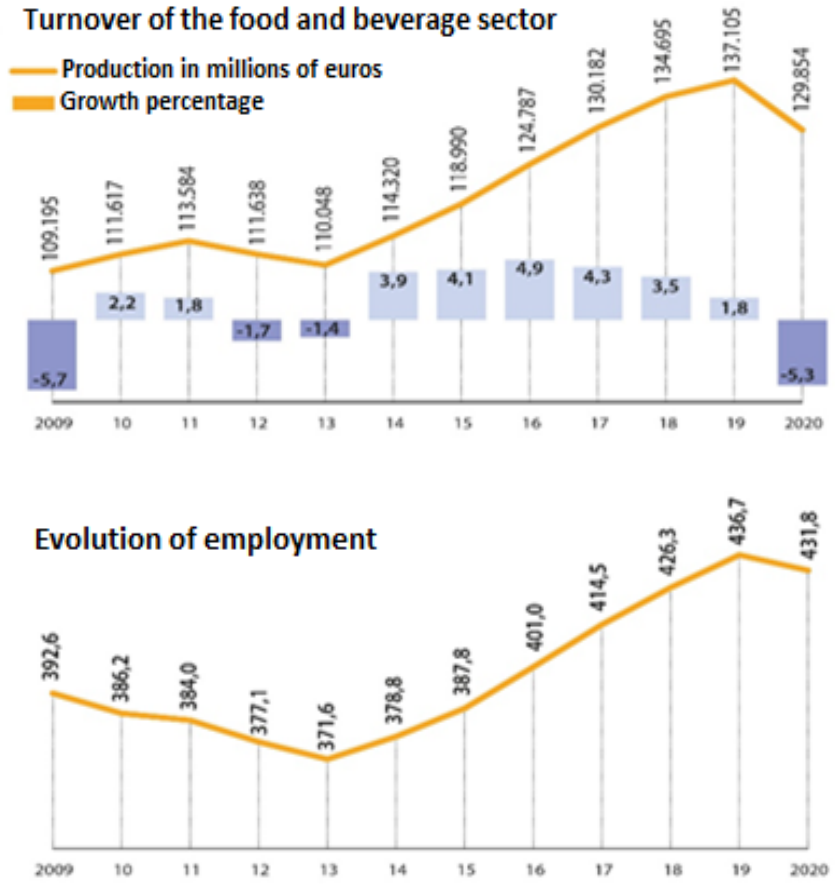
In Spain, the food and beverage sector is the leading manufacturing branch of the industrial sector, according to the latest data from the INE's Structural Business Statistics for 2020, with 125,841.8 million euros of turnover, which represents 22.8 % of the industrial sector, 21.5% of employed persons and 18.9% of added value. It represents 2.6% of the GDP which is 30,342 million euros. The number of companies in the food and beverage industry amounts to 30,573, according to the latest data from the INE Central Business Directory, which represents 15.6% of the entire manufacturing industry. Furthermore, it must be added that 16% of the net sales of the Spanish industry correspond to this sector (INFECO, 2019).

The food and beverage sector is a diversified sector since it is made up of SMEs, in the vast majority of cases. In addition, it is the main sector in countries such as Germany, France, the United Kingdom, Spain, France and Italy.

Despite the good situation of the sector in recent years, the food and beverage sector experienced a decline in 2020 after years of growth due to the health crisis caused by COVID-19. According to the economic report of the Spanish Federation of Food and Beverage Industries (FIAB), the sector lost 7,251 million euros of production which means a fall of 5.4% compared to the figures of 2019. Regarding the gross added value of the sector, it fell by 8.6% due to the high decrease in tourism.

In the following table, it can be seen the impact that this sector has in Spain. The illustration (illustration 3) depicts that the decrease in turnover is reflected in the evolution of employment, which had been growing since 2013.

**Illustration 3, Total turnover of the Food and Beverage sector from 2009 to 2020**

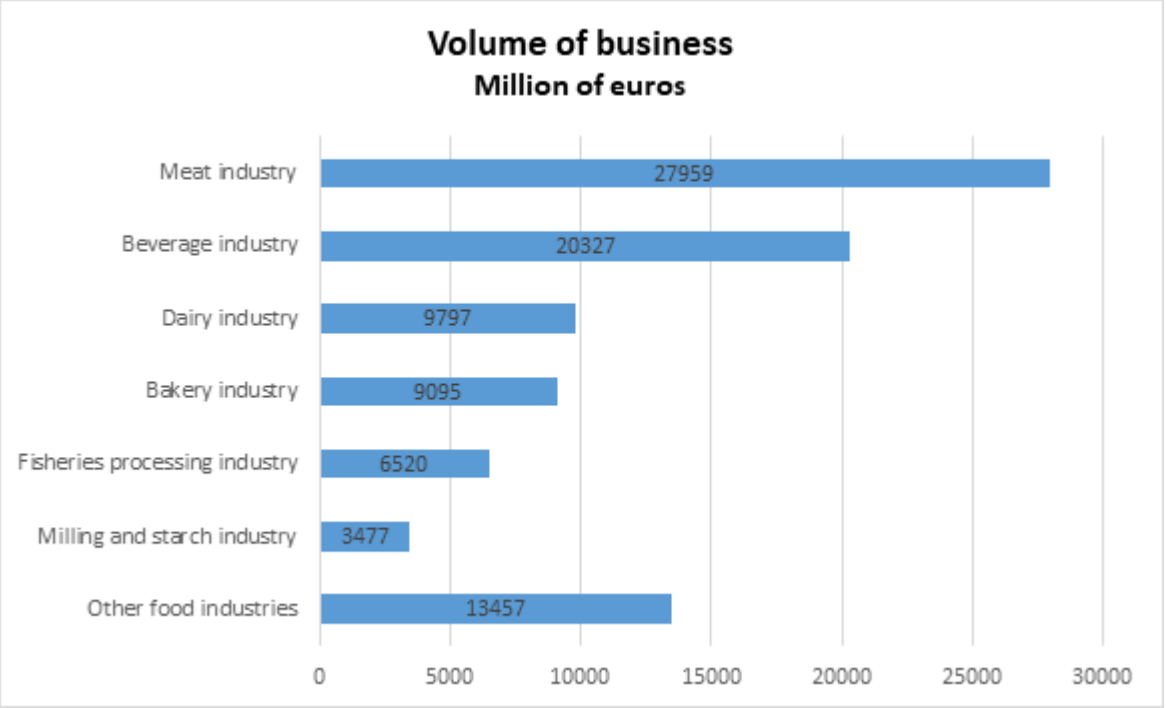



***Source: INE, (2018)***

However, it should be highlighted that the food and beverage sector has become a key sector during the COVID-19 pandemic. The food and beverage sector has performed an essential activity since it has supplied the population with food. During the months of confinement, the entire food chain made up of farmers, ranchers, fishermen, cooperatives, as well as the food industry including wholesalers, retailers, distribution and logistics had to adapt quickly to supply food to the population.

Now the different sub-sectors of the food and beverage sector will be analysed from a circular economy perspective. In the following graph (illustration 4) it can be seen the turnover of the 7 main sub-sectors. However, only 6 will be examined during this work. These sub-sectors analysed are the fisheries processing industry, the dairy industry, the bread and milling industry (which includes the bakery and pasta sectors and the milling sector) and finally the beverage industry. Therefore, the rest of food products will not be analysed in the following sections.

**Illustration 4, Main Food and Beverage Sub-sectors Turnover**




***Source: Ministerio de Agricultura, Pesca y Alimentación from INFECO (2019)***

In the first place, the graphic shows that the meat industry is at the top of the turnover list in all sectors. An explanation could be that the meat industry is the fourth industrial sector in our country, behind the automobile industry, the oil and fuel industry, and the industry of electrical energy production and distribution. This sector is made up of slaughterhouses, cutting plants and processing plants. Furthermore, it is formed by more than 3,000 companies distributed throughout Spain although they are concentrated in rural areas. Some of these companies are leaders on a European scale even though a significant part of this sector comprises small and medium-sized companies.

The meat industry occupies the first position in the Spanish food and beverage industry due to the joint production of the meat companies. The leading position is represented by a turnover of 27,959 million euros and 22.6% of the entire Spanish food sector.

This turnover represents approximately 2.24% of the total Spanish GDP (at market prices), 15.6% of the GDP of the industrial branch and 4.2% of the total turnover of the entire Spanish industry. The meat industry comprises 97,076 workers, representing 23.8% of the total employment of the Spanish food industry. A relevant fact is that the meat industry exported more than 3.2 million tons of meat including all kinds of processed products in 2020 (INE, 2019).

The beverage industry occupies the second position. This sector is one of the most complicated sectors to analyse in depth because it contains a large number of sub-sectors with a powerful impact within the food and beverage market. It is worth mentioning that the figures are from each sub-sector individually rather than the whole sector. The following table (table 2) corresponds to the total consumption of the year 2019. There are 8 hugely important sectors in the industry which are wines and their by-products, beers, spirits, juices and nectars, bottled water and soft drinks. In the graph, it can be seen the volume of sales, the value in thousands of euros and the per capita consumption in kilograms of each of these subsectors (INFECO, 2019).

**Table 2, Beverage Turnover in 2019 of the different products in beverage industry**

| Year 2019 | Volume (millions of Kg) | Value (millions of Kg) | Per capita consumption |
|---|---|---|---|
| **Wines** | 305.976 | 860.485 | 6.7 |
| **Derived from wine** | 69.443 | 109.486 | 1.5 |
| **Beers** | 763.483 | 1.006.752 | 16.6 |
| **Spirits** | 27.095 | 289.321 | 0.6 |
| **Juice and nectar** | 347.545 | 367.434 | 7.6 |
| **Bottled water** | 2.610.822 | 546.006 | 56.9 |
| **Soda** | 129.049 | 37.560 | 2.8 |
| **Refreshing drinks** | 1.504.769 | 1.338.619 | 32.8 |

***Source: Own elaboration, from FIAB (2019)***

The manufacture of beverages represents a turnover of 20,327 million euros. This sector is formed by 5327 companies and a total of 54350 people working in it. This means that around 12% of all people who work in the food and beverage sector belong to the beverages industry.

The bread and milling industry is in the third position of the ranking. The bakery sector has crucial importance at European and national level. According to the latest data taken from the INE, the companies dedicated to the manufacture of bakery products and pasta

comprises 10,558 companies with a total turnover of 12,572 million euros. The latest data from the FIAB (Spanish Federation of Food and Beverage Industries) report indicates that the bakery industry is the second sub-sector in relation to employment, generating 21.85% of jobs in the food and beverage sector. In this way, it indicates that the bakery sector employs 96,075 people (INFECO 2019).

This industry is characterised by working hard to improve production and distribution processes in order to be more competitive in the market. Thereby, this sector dedicates a large part of its profits and turnover to investment. The average investment per company is 1.5% -3% of its profits and it is the sector that invests the highest quantity in R + D + i.

Regarding the industrial sectoral structure, most of the companies that make up this sector are members of the Spanish Association of the Bakery, Pastry and Pastry Industry (ASEMAC). This association brings together more than thirty companies located in the different autonomous communities. Moreover, AEMAC represents 80% of the companies in the sector and about 90% of its sales. During 2019, the industrial production of the companies belonging to Asemac increased by 4.3% on average and produced 728,097 tons.

However, this sector has been one of the most affected by the COVID-19 crisis, since business figures were greatly reduced during the 2020. Total sales dropped by 12.4% with respect to 2019.

The dairy industry occupies the fourth place which is represented by a turnover of 9,797 million euros. The chain of production, transformation and commercialisation of the dairy sector (beef, sheep and goats) bears great relevance in the Spanish food sector since it employs more than 60,000 people. Besides, the dairy industry represents 2% of the industrial production of the whole country and constitutes 8.5% of the food sector employment (INE, 2019).

In 2020, the total volume of cow, sheep and goat milk in the Spanish dairy industry shows that more than 8.400.000 tons of milk are consumed in Spain each year. In the context of the EU, Spanish cow's milk production represents 5% of the total, compared to 15% and 20% for sheep's milk and goat's milk, respectively. Currently, Spain is the second country in the EU that produces the largest quantity of sheep and goat milk.

The consumption of dairy products in our country has remained slightly similar compared to previous years. Milk is the most consumed product within Spanish households (3,194,952 tons), followed by yogurt (664,932 tons) and cheese (359,935 tons) making a total of 4,916,156 tons.

The fishing industry is in the fifth position which shows a favourable situation in Spain, despite the significant administrative and regulatory pressure it has endured in recent years.

The Spanish fishing sector generates 20% of the total fish production of the European Union. The Spanish fishing industry is a leader at the European level both in terms of volume (889,333 tonnes of fish and shellfish in 2020) and in terms of global turnover (2,043 million euros in 2019) (INE, 2019).

This sector generates 31,473 direct jobs, turnover of 6,520 million euros and contributes 0.5% of GDP. In addition, it is a sector that has been experiencing growth in recent years. An example of this could be that in 2019, fish exports including frozen fish and fish canning, grew by 4.29% compared to 2018.

Another aspect to highlight is that a wild fishing stagnation is expected due to the increase in fish consumption in recent years. As a consequence, the production of fish farms will increase. Nowadays, aquaculture represents 30% of world fish production and it is estimated that this percentage will continue increasing exponentially until reaching similar figures to the ones in Asian countries such as China or Vietnam, which comprise 87% of their total fish production.

Once all the sub-sectors have been introduced, it should be noted that the food and beverage sector is one of the mainstays of today's consumer society. Through the intensive use of resources, an economic production model which seeks to maximise the desired product in the short term has been established. Companies have to face the challenge of meeting society's food needs through a sustainable, environmental and economically viable production model. The application of the circular economy is an appropriate model to solve this challenge. The circular economy represents a systemic shift which provides environmental and societal benefits. It is related to the idea of “closing the circle” of production, using waste as new raw materials and promoting synergy between the different parts of the system.

As a result, the food and beverage industry faces a number of challenges and therefore, it needs to be adapted to the new economic paradigm so as to keep rising. Aspects such as the COVID-19 crisis, the global water resources crisis, the new trend towards ecological agriculture or an energy transition means that this sector requires significant adjustments with the aim of adapting to the changes. Two main reasons can trigger these changes. The first one is variations in the population's action patterns since these are constantly changing due to different aspects such as new healthy lifestyle habits or greater awareness on environmental and sustainability issues. environmental. The second reason is because of

necessity. That is to say, there are a series of environmental problems which are not currently addressed correctly although in the coming years, they will have a huge impact on the plante's situation. For these reasons, the circular economy is seen as the necessary inflection point that may provide feasible solutions necessary to the mentioned challenges (Unamuno, 2020).

Therefore, in the following sections it will be analysed what companies in the different sub-sectors are doing to promote the circular economy given that this is the greatest challenge in the food and beverage sector.

# 4. ANALYSIS OF THE RESULTS

In this section the results obtained in this investigation will be presented. Three main lines of action have been explored in detail in relation to the situation of the circular economy in the Spanish food and beverage sector.

These three main lines are:

A. General analysis of the current situation and the lines of action developed in the food and beverage sector with the purpose of circular economy transition.

B. Analysis of the main strategies adopted by the previously analysed sub-sectors as well as to the innovation and technological development of each sub-sector.

C. Success cases of the circular economy in the food and beverage sector.

In the following subsections the main results obtained in each of the three lines of actions will be shown.

## 4.1. Circular economy in the different sub-sectors of the Spanish Food and Beverage sector: the present situation

In this first section, we are going to introduce the degree of implementation of the circular economy in the different sectors comprising the Spanish food and beverage sector. As one of the most important points regarding circular economy design is related with waste management, in this section the analysis will be carried out through the description of the waste management situation in the main sub-sectors comprising this big industry.

The food and beverage sector is formed by different sub-sectors although only the five principal sub-sectors in this industry will be examined. These sub-sectors are meat industry, fisheries processing industry, dairy industry, bread and milling industry and beverage industry.

### 4.1.1. Meat industry

The first aspect that should be highlighted related to waste management within the meat industry is water consumption. It is a paramount point since high quantities of water are

needed for a large amount of processes such as washing slaughterhouses, cleaning the cattle before being slaughtered, washing transport vehicles or cleaning corrals among others. In addition, water is highly related to the generation of liquid effluents.

In addition to water wastes, meat industry's waste is mostly formed by cattle's blood and meat waste from animals including hairs and excrements among others (Bustillo-Lecompte & Mehrvar, 2015). Due to the large amount and variety of waste originated in the meat industry, the liquid effluents can be separated into two different groups which are red effluents and green effluents.

Red effluents are those that are composed mainly of blood traces coming from the bleeding or the cleaning of animals. On the other hand, green effluents would be those coming from stomach remains, vomiting, urine, dung or livestock hair (Gazzete, 2010).

As a consequence of the current regulations implemented, these effluents must have specific composition values in order to be discharged. For this reason, effluents must be treated in most cases due to the amount of hazardous waste they contain. The effluent treatments used in the meat industry are: physical, physical-chemical and biological (Labamerex, 2015).

The first treatment, physical treatment, aims at reducing the generation of odours and optimising the chemical products used in the processes of the meat industry. The main physical treatments used are roughing, sedimentation and flotation. Roughing removes solid contents to ensure the protection of subsequent installations, sedimentation separates the heaviest particles suspended in the water and flotation separates the insoluble parts that are in the effluents.

The second treatment is the physical-chemical treatment in which two processes called coagulation-flocculation and disinfection can be distinguished. Coagulation-flocculation consists of separating those particles that are still suspended in the effluent through the use of chemical substances. On the other hand, disinfection is used for the elimination of microorganisms present in the final effluents before being discharged by means of disinfectant substances, such as hydrogen peroxide or pathogenic to name a few.

After the physical and physical-chemical treatments, if there is still organic matter dissolved in the effluents, the biological treatment is carried out, which consists of joining the effluents with microorganisms. Those microorganisms need nutrients present in the effluents in order to be metabolised.

The vast majority of waste generated are effluents and water-related waste, although there are other sources of waste within the meat sector which could divide into three main groups:

- Organic waste: In this group, livestock's manure, animals' food scraps as well as the mud obtained after handling the mentioned liquid effluents are included. This type of waste can be employed in different areas, and it is mostly used to make agricultural fertilisers, for this reason, organic waste is the least hazardous**.**

- Inert waste: This type of waste is related to materials such as papers, cartons, plastics and glass used in processes such as meat packaging, transport and beef meat storage.

- Pathological residues: It is generated as a result of the use of veterinary inspections products, since animals' health is being continuously assessed by veterinarians to ensure that they have optimal conditions. It is an essential procedure because these materials are aimed at human consumption.

Within these three groups, it should be highlighted the organic waste subgroup because it is considered the most complex due to a great number of factors. The organic waste generated can be treated biologically through different processes (Labamerex, 2015).

The first type of treatment is the aerobic composting process, which consists of performing a series of processes trying to biologically degrade the biodegradable waste. When biodegradable waste is exposed to an environment with favourable conditions of both temperature and humidity and to an environment in which oxygen is present, it becomes a stabilised product and can be used as a fertiliser for the soil. On the other hand, aerobic composting can also be performed by using worms. It can be explained by the fact that worms help to accelerate degradation processes under a set of conditions.

The second type of treatment is the anaerobic process, it is done in reverse of the aerobic process. In the anaerobic process, residues are exposed to an environment without oxygen. In this way, thanks to the natural action of bacteria, they transform organic waste into biogas or mud that can be used as fertilisers after being treated (Bustillo-Lecompte et al.,2013).

We can conclude that the meat sub-sector generates a great deal of waste, mostly in the form of liquid effluents. Effluents are a serious problem for companies since dealing with effluents is a high-demanding task. However, if companies implement circular economy strategies, this problem could be solved and wastes could be given a second use.

### 4.1.2. Fisheries processing industry

In this sub-sector, one of the main environmental problems is related to the high energy demand required to carry out actions such as the propulsion of the vessels, setting the machinery into motion or any aspect related to fish distribution to the market.

Regarding the energy needed in this sector, this industry makes use of petroleum, its by-products as well as natural gas. These resources are not only harmful to the environment but they are also finite and industries are depleting natural reserves (Farnet, 2019).

For these reasons, continuous improvements are being made in order to reduce emissions. Some of the initiatives are the following ones:

- Supporting fishing vessels and changing their fishing gear so as to reduce their current fuel consumption.
- Trying to adapt the engines of the vessels so that they are less dependent on fossil fuels.
- Promoting the use of renewable energies in the fishing vessels and in the post-fishing activities such as sales or fish processing with the aim of becoming more energy efficient.
- Insulation of refrigerating chambers and use of more efficient machinery.

First of all, two main groups can be differentiated within the fishing industry which are aquaculture and wild fishing. Although aquaculture and wild fishing carry out practices with the same product, fish, they manage waste differently.

Firstly, aquaculture generates large quantities of waste since fish excrements can become toxic. On the contrary, if there is a proper management of fish excrements, fish faeces can be employed to generate nutritious products used in the soil or in agricultural activities given that excrements' by-products accelerate the growth of plants. Therefore, most of the solid waste generated by aquaculture is intended for the production of agricultural products, for instance, fertilisers (Farnet, 2019).

Secondly, wild fishing produces even more residues than aquaculture owing to fish discard. Once fish and shellfish have been caught, there are useful residues, mainly organic, which can be utilised in other practises. Most of wild fishing waste is formed by fish which have been discarded for the following reasons:

- The fish is smaller than the legal size and consequently, they cannot be sold.

- Species that are not profitable for fishermen because there is a lack of consumer demand or species that have a low sale price on the market.

- Fishing market mismatch caused by the law of supply and demand.

The rest of the residues are discarded parts of fish after being processed such as skins, viscera, thorns etc.

In summary, it can be said that this sector generates large amounts of waste. The wastes which generate more environmental problems are those related to the fuel used by fishing boats since they pollute the environment. Nevertheless, the rest of residues generated by this industry can be used as raw material for the production of other products. For this reason, with a good management of this fishing waste it could be a sustainable sector.

### 4.1.3. Dairy industry

Within the dairy industry, the main problem to be addressed is the generation of wastewater during most of the processes. This is due to the large amount of water generated as well as to the high polluting load wastewater that it contains. For this reason, sewage water negatively affects the environment and can lead to health-related and environmental issues.

As published by Condorchem Envitech (2013) between 80-90% of the water used in this industry for the dairy production ends up being effluents since wastewater contains a large concentration of pollutants which are hard to be purified, treated or recycled by traditional and conventional methods. Untreated wastewater is highly polluting and thereby, there is a need to treat it before discharging wastewater into the environment.

The main practices contributing to the creation of polluting waste within the dairy sector are arose from:

- The cleaning of facilities and equipment employed for the production processes.

- The cleaning of the means of transport responsible for transporting the raw material.

- Not using ultrafiltration systems used to treat the residues generated. Moreover, osmosis systems utilised for the processing of a great number of dairy products should be avoided.Through the osmosis process, water is purified by removing all the solid waste it contains. Thanks to the water treatment, sewage would no longer be considered waste.

Regarding the concentrations of effluents within companies, there can be large variations from one plant to another and this can be due to the fact that each plant carries out different practices. The main reasons for these differences would be the following ones:

- The degree of water consumption optimisation of the company.
- The way in which cleaning procedures are performed since the chemicals used highly influence the cleaning process.
- The technology used in the process in which water is present, because technology can optimise water-related processes.
- The changes arising from the different variations that the manufactured products have experienced over time.

Most of the companies in the dairy industry need to consume high amounts of water daily, not only for the starting up the production processes, but also in order to establish both hygienic and sanitary conditions in an industry in which hygiene and sanitisation are key elements.

For these reasons, depending on the practices that are carried out, in most cases, the water used in the dairy processes significantly exceeds the volume of milk that has been treated.

According to Oneţ-Cristian (2010), the dairy industry requires from 2.5 to 3.2 litres of water per litre of milk processed. Nevertheless, in some cases these values can be greatly increased to 10 litres of water per litre of milk.

Water can be reduced with the help of the suitable equipment in each process, as well as with a great manager's praxis. Hence, if dairy factories adopt a good pattern of action, consumption will decrease up to 0.8 and 1.0 litres of water per litre of milk.

As already analysed, this sub-sector is characterised by employing huge quantities of water for every process. Thereby, the companies of the dairy industry have to focus their strategies to reduce water consumption and reuse water. In this way, the high percentage of water which ends up as an effluent can diminish.

### 4.1.4. Bread and milling industry

The bread and milling industry is regarded as the cleanest industry, given that his industry hardly generates polluting nor hazardous waste. It is explained by the fact that the waste

generated is recycled, and that the bread and milling industry makes use of cereal, yeast, as well as fats and butter resources produced in the country where they are located.

In order to be a cleaning industry, it is essential that the components of the linear wheat-flour-bread procedure undertake to try to make as little negative impact as possible on nature (Naryhus, 2006).

The first link in the chain is the cultivation of the cereal itself, usually wheat. This cereal would be the raw material around which this sector revolves. The processes previous to the wheat harvest such as sowing, irrigation, fertilisation or the harvest of the cereal itself are of extreme importance.

As a result of the good practices carried out by farmers and bakers, a sustainable process has been achieved. The bread and milling industry not only obtains a final high-quality product but also it is environmentally friendly.

The second link in the chain is the process by which the wheat grain is transformed into flour. Flour companies are aware of the considerable energy costs present during this stage. For this reason, these companies have attempted to minimise their environmental impacts in all areas of action, through an economic, social and environmental commitment.

In this context**,** it is worth mentioning that most of the emissions produced come from the factories where the flour is handled and processed, more specifically, in the suction systems where flours, brans or semolinas are produced. However, it is necessary to bear in mind the fact that flour is a biodegradable product and consequently, it has no negative impact on the environment in any of its life cycles which are handling, consumption and waste.

The third and final link in the chain is formed by the bread producers. In this sector, bread producers have joined forces to promote a sustainable industry by regulating the bread production processes through cogeneration and the significant reduction of harmful gases emissions.

Therefore, the bread and milling industry can be considered a sustainable industry. In addition, this industry makes use of cereals which have been produced in Spain and water resources located in the communities where the flour factories are situated. That is to say, the bread and miller industry respects the natural environment and it is concerned about the sustainability of the country (Gommes. R, 2004).

### 4.1.5. Beverage

The beverage industry is a broad sector in which there are 5 main sub-sectors: beer, wine and cava, refreshing beverages, juices and bottled water.

The first sub-sector is the brewing industry. This is characterised by generating a large amount of organic waste. Most of the brewing industry generates recoverable waste, that is, waste that can be reused.

Organic waste is mostly known as RMC, that is, beer malt residue. The RMC represents 85% of the total waste generated by the brewing industry. This product is obtained after the maceration process. In the maceration process, the part of the barley grain that cannot be dissolved becomes wort. RMC production is estimated to be one-fifth of the final product, so out of 1000 litres of beer we brewing industries would get 200 kg of RMC. The positive part of this residue is its composition, as it ends up being a raw material intended for food (Donner et al., 2020). RMC has high nutritional values considering that it consists of 45% fibre, 25% protein and the main nutrients needed for people.

For these reasons, RMC ends up being an ingredient used in the production of numerous foods such as fruit juices, sausages and especially, many pastry goods.

In addition to the RMC, large amounts of wastewater are also generated as a result of the myriad number of carried out actions in which water is necessary such as in the cleaning processes of tanks, small bottles or machinery. The brewing industry is highly reliant on water since in order to produce one litre of the final product, from 3 to 10 litres of water are required depending on different circumstances within each brewing industry.

In this case, the generation of wastewater can be divided into two groups:

- The first group is the generation of wastewater in the first stages of the production process, including the manufacturing and fermentation of wort and the maturation of beer. This group is characterised by generating a greater number of organic residues although a lower volume of water is needed.
- The second group is related to cleaning. A higher volume of water is needed, but it generates a lower organic load compared to the previous group.

The second subsector is the  wine industry, which generates around 3 million tonnes of waste per year in Spain. Despite the high figures, the positive aspect is that 85% of the residues are organic.

Organic waste comes from vineyards as a result of agriculture practices such as prunings. Nevertheless, most of the waste is generated in the wineries and it could be classified as follows (Sehnem et al., 2019):

- 62% would be orujos that arise from the processes related to the grape-pressing, which are commonly composed of skins and seeds.
- 14% would be lees, obtained by wine fermentation processes, specifically when the wine clarifications are made.
- 12% would be wine scrape, which consists mainly of foliage and wine branches.
- 12% would be sludge taken from the purifier system which has been formed during the treatments of the winery wastewater.

The third sub-sector is the refreshing beverages industry. In this industry, the main objective of companies is to eliminate the waste which is sent directly to landfills. Alternatively, the refreshing beverage industry is committed to reuse waste for subsequent usages.

Packaging is the stage in which the largest amount of waste is generated (Sterling, 2008). This type of waste includes aluminium, cardboard, glass or plastic and packaging. The waste generated in this industry can be classified into direct and indirect waste.

Direct waste is the one which has been generated during the production processes. Furthermore, direct waste is usually composed of the rejected materials used during the packaging process of refreshing beverages.

On the other hand, it is known as indirect waste the residues derived from product packaging such as pallets, cartons and plastics. It is worth mentioning the vast number of cans produced in this sector since several types of beverages are stored in cans.

The fourth sub-sector is the juice industry. Large amounts of wastewater are generated since high concentrations of water are needed for juice production. Approximately 75% of the total water consumption used for different processes during juice processing ends up being discharged as residual water. The remaining 25% ends up being evaporated. It is worth mentioning that the residual load of the effluents mainly comprises organic matter such as peels of fruit or mineral salts (Martínez, 2019).

It should be mentioned that in this sub-sector, unlike the other sub-sectors, the waste obtained is potentially usable for other areas completely different from the juice industry. Thus, it is one of the most environmentally safe industries.

The fifth and final sub-sector is bottled water. This sub-sector generates elevated quantities of waste**.** The main problem arises as a result of the large amount of plastics needed for the manufacture of the bottles in which water is subsequently sold. The bottled water industry generates about 1.5 million tonnes of plastic annually. The main problem is when plastic is not recycled given that plastic takes about 450 years to break down because it is an oil derivative (Iagua, 2018).

Spain is the sixth country in Europe in the ranking of bottled water consumers although it is one of the countries along with Germany, Italy and the United States that have the cleanest drinkable water and the most suitable water for human consumption. Moreover, according to data published by El Diario (2019), bottled water is 125 times more expensive than drinkable water.

The bottled water industry and strong companies in the sector make the society believe that bottled water is healthier and that bottled water tastes better than drinkable water. Nevertheless, numerous studies have shown that people have preferred drinking water rather than bottled water for its best taste (Iagua, 2018).

Drinkable water in Spain is a product that requires a high number of sanitary controls and regulations aimed at protecting public health.

To sum up, in the beverage sector, packaging plays a key role in the distribution and storage of beverages. Without appropriate packaging, beverages could not reach the final consumer so beverages have a dependence on packaging in order to be consumed. For these reasons, millions of waste related to the manufacture of packaging is generated annually. Hence, it is essential to properly manage waste so as to reduce the impact plastics, cartons, cans and glass have on the environment. The recycling awareness of the population and the commitment of citizens are relevant in order to ensure the sustainability of our planet.

## 4.2. Strategies implemented for circular economy transition in the different sub-sectors of Spanish Food and Beverage industry

Once we have described the waste management situation in the different sub-sectors comprising the food and beverage industry, we are going to analyse how they have introduced different strategies to fulfil the circular economy requirements.

The companies of the sectors analysed have been forced to establish several strategies and practices to manage all the waste generated within the different production processes of each sector.

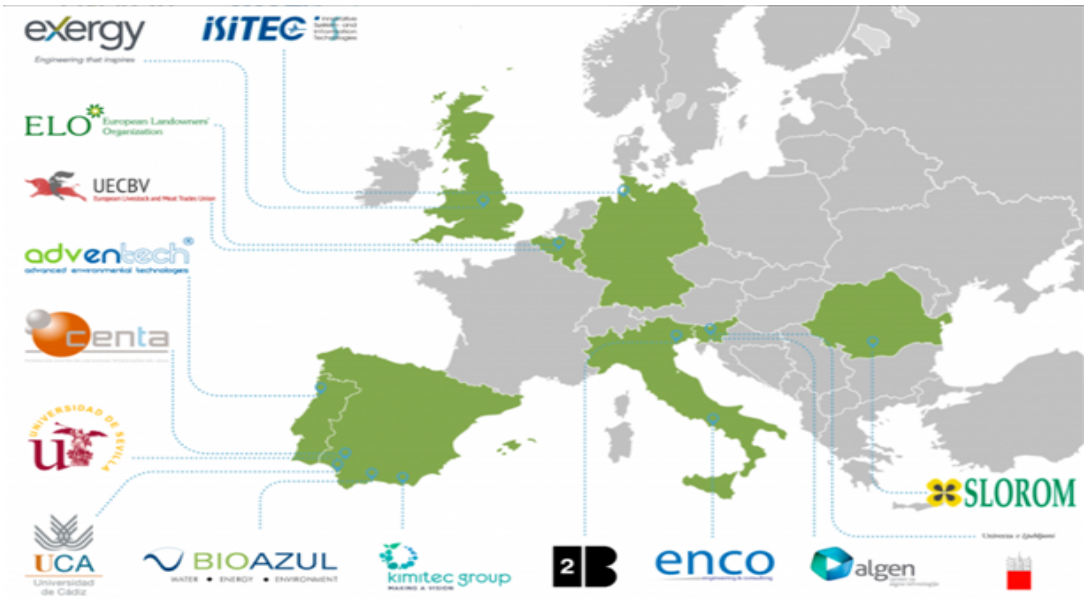
Companies need to implement circular strategies since they are being pressured by public entities. Therefore, companies are required to handle all their waste so as to reduce the negative impact on the environment (Bocken et al., 2016).

In the following sections, the strategies carried out by the different sub-sectors belonging to the food and beverage sector in Spain are described in detail.

### 4.2.1. Meat Industry

As previously mentioned, the principal problem in the meat subs-sector is the generation of liquid effluents. These liquid effluents must have particular composition values to be discharged. For this reason, most companies in the meat industry simply treat their effluents in such a way that they can be discharged legally. For this reason, the European Union is investing in R&D and is financing numerous studies for the treatment of effluents. One of the projects which is being designed by 15 multidisciplinary entities, more specifically 9 SMEs, 3 universities, 2 European associations and 1 research centre from 8 European countries is the *Water2Return* project (Water2Return, 2017).

**Illustration 5, Companies and countries participating in the Watern2Return project.**




***Source: Business Europe, 2018***

The countries involved in this project are: United Kingdom, Germany, Portugal, Romania, Italy, Slovenia, Belgium and it is led by Spain. This project is a circular economy strategy applied to the conversion of slaughterhouse wastewater treatment plants into biorefineries. The aim of *Water2Return* is to provide an innovative, sustainable and convenient solution to process slaughterhouse wastewater and obtain added value products.

*Water2REturn* contemplates obtaining biostimulant products from the sludge generated in the treatment of wastewater through an innovative fermentation process. Furthermore, it fosters synergies between the food industry and sustainable agriculture and proposes new business models to open up market opportunities with special attention to SMEs. Using the knowledge and previous experience of the research centres, universities and companies participating in this initiative, *Water2Return* will not only make available to society a solution to reduce the waste generated in slaughterhouses and other meat industries but also it will reduce the demand for chemical fertilisers in the sector. It is a project under the H2020 call, a program which finances research and innovation projects in different thematic areas in the European context. It is the largest research and innovation program in the EU with almost 80 billion funds available over 7 years (2014-2020) (Water2Return, 2017).

Another type of waste generated by the meat industry is organic waste which can have different origins. On the one hand, there are meat by-products that are not used for human consumption due to commercial, health or legal reasons.

Spain is the second European producer of animal by-products and its transformation industry is grouped in the National Association of Fats and Animal By-products Transforming Industries (ANAGRASA)(ANAGRASA, 2018). It is not only a technologically prepared sector with experience in converting these materials into new resources but also it is an industry that works for the safety of the food chain and contributes to the transition towards a circular economy, through an efficient management of Animal By-products Not Intended for Human Consumption (SANDACH) (Agronegocios, 2019). These by-products can be transformed into new resources that could divided into three groups:

- Category 1: Fuels, biodiesel and fertilisers.
- Category 2: Food for animals and biogas production.
- Category 3: Pet food, fish food and chemical industry.

Within this industry there are different companies which are centring its activity in by-product transformation such as *Ganados Jiménez Cambra*, which is exclusively dedicated to the production of feed. Another example is *Subcarn Echevarria*, a company located in Lleida which is the most representative of this sector and it is pioneer in the treatment of

by-products. Moreover, it is one the few companies that manufacture a great deal of different products and hence, it is a diversified company. Furthermore, the company works in two plants located in Lleida and another one in Cervera with the aim of producing products from the three categories mentioned above. The two plants of Lleida, collect and process animal by-products not intended for human consumption coming from farms (category 1 and 2). On the other hand, the plant located in Cervera treats category 3 by-products coming from slaughterhouses and cutting plants (category 3). Subcarn collects the raw material generated (meat by-products) from the cutting rooms and slaughterhouses. Then, the company takes the raw material to its plant, checks the product in the laboratories to finally process it and produce a product ready to be sold (Subcarn Echevarría, 2016).

On the other hand, livestock feces (slurry, manure, etc…) are also generated and they are one of the most abundant residues. They are commonly used as fertilisers. These wastes can be biologically treated through the aerobic composting and anaerobic processes. In the aerobic composting process, waste is transformed into a stabilised product when exposed to an environment with favourable conditions and in which oxygen is present. In the anaerobic process, waste is exposed to an environment that lacks oxygen. After that it is converted into biogas or sludge that can be used as a fertiliser after being handled (Labamerex, 2015).

In order to find an eco-friendly and economically profitable solution to livestock slurry, four Spanish partners led by the Valladolid technology centre worked on the European project of *LIFE Mix-Fertilizer Program* in 2016. The program lasted three years and it had a budget of 1'2 million euros. The final objective was to value these slurries by creating new mixed fertilisers which in turn, improve the yield of the crops. This program has been formed by the *CARTIF* technological centre and the companies *Purines Almazán S.L (PURAL)* and *Servimed S.L* (LIFE Mix- Fertilizer, 2016).

Servimed company has ended up obtaining new fertilisers from composted organic waste and ammonium sulfate in the form of pellets. Besides, they have been tested on crops and they provide more benefits than currently commercialised products.

Currently, around 50 million tons of slurry are produced per year in Spain. However, only 2.5 million are treated in the 19 plants operating in the country. This is because the main use of this waste has been generating energy, specifically generating biogas. Therefore, there is a need to work more on this issue (LIFE Mix- Fertilizer, 2016).

An example of good practices of the circular economy in the meat industry is the company *Campofrío* since it has obtained the *Zero Waste Certification* from *AENOR* at the La Bureba plant in Burgos. The company has become the first company in the meat industry to obtain

this certificate because they recycle 90% of the waste generated. For the purpose of adapting the operation of the plant to an environmentally sustainable system, a great number of measures have been introduced, including the segregation of all waste fractions to maximise their valorisation. In order to do this, new equipment has been incorporated in the final clean point (AENOR, 2020).

In short, after exploring the strategies carried out in the meat sector, it can be concluded that this sector generates a great variety of different wastes. The positive aspect of this situation is the large number of products that can be made with this waste including animal feed, compost or even fertilisers. Nevertheless, more research needs to be conducted so as to reach a large number of solutions regarding effluents' treatment.

### 4.2.2. Fisheries Processing Industry

The main source of waste generation within the fishing industry is related to waste and the discards produced. The problem is accentuated as a consequence of the current laws regarding fish waste. Since January 2019, dumping waste overboard is completely forbidden for boats. For this reason, every fish or shellfish taken out of the sea during the fishing day must be unloaded at the port. As a consequence, a series of practices have been carried out with the aim of giving the catch another uses and promoting the circular economy.

One of the practices would be using the waste obtained such as little commercial value fish or fish that do not reach the minimum size, among others and giving them a second life. For instance, they could be processed and transformed into fish ingredients and oils to prepare livestock feed.

It is a great opportunity to take advantage of these residues since fish provide animal feed with beneficial properties because of fish composition. Fish contain high protein levels necessary for the production of feed. These flours and oils are not only used to feed different types of livestock, but they are also used to make feed for the fish themselves within aquaculture (Farnet, 2019).

Regarding the companies producing flour coming from fish and fish oils, it can be said that they are located throughout Spain. It is worth mentioning that in the last 30 years the companies dedicated to the production of fish oils and fishmeal have been reduced. However, these companies have joined together and currently they are larger and more technologically developed than before. 40% of all fishmeal produced in Spain comes from companies located in the autonomous community of Galicia such as *Conresa* and

*Conservera Areoso*. The explanation for this phenomenon can be explained by two main causes:

- The importance of the fishing sector in the Galician provinces. This is due to the fact that the GDP of around 20% of all the coastal villages in Galicia exceeds 10%. Although the average GDP of the fishing sector in Galicia has an average of 2.1% of the total economy, for many regions it is a prosperity sector (Vázquez, 2015).

- Galicia is the area of the Spanish territory in which most of the fish canning and processing companies are located. These companies produce large amounts of fish waste which are used to make fishmeal and oils (Vázquez, 2015).

Spain is one of the countries showing solid support for the circular economy in the fishing industry. Many countries such as the United States or Peru fish exclusively for the elaboration of fish by-products like fishmeal and fish oil. Nonetheless, the Spanish factories use the fish catches which have been discarded to elaborate fishmeal and fish oil instead of directly throwing them out. For this reason, Spanish factories do not imply a negative impact on the fishing grounds.

The most common raw material used for the elaboration of the flours particularly comes from three species of fish which are tuna, sardine and mackerel. The fishmeal produced is entirely destined for the production of animal feed. The main destination is aquaculture since around 55% of these flours are used for the production of fish feed (Eolapaz, 2019).

One of the most important companies in this sector is the fish canning company *Aucosa* in Vigo. In 1966, this company created a factory in order to process fishing by-products. This company was a pioneer in the production of fishmeal and fish oils. At present, it is a company constantly being renewed and it is adapted to both production and environmental standards in order to become one of the most modern and efficient companies in the entire European continent (Lence, 2021).

On the contrary, there are companies such as *Pescados Y Salazones La Higuerita SL.* and *Biomega Nutrition* that use fish waste for the production of other products intended for animal feed such as:

- Fish silage: it is a liquid preparation made by mixing fish or its residues. Fish silage is generally used as a substitute for fishmeal, as it has very similar characteristics. In addition, it is cheaper than flour, since the technique used for its production is simpler than the one used to produce flour.

- Fish protein hydrolysates: it is a preparation obtained from the processing of the fish viscera. The digestive parts of fish have a high nitrogen content which is used to make feed for other animal species such as pets or aquaculture animals since they require an elevated concentration of this element.

- Protein from fish waste: it is the most protein discarded parts of fish whose main use is the production of pig and poultry feed.

Treated fish waste has many applications among which the most popular are animal feed, biogas, cosmetics and fertiliser among others. An example of a circular company is *Regal Springs*, a fishing company that reuses 100% of its waste.

Fish scale and skin residues are used in gelatin and collagen for pharmaceutical products (Jayathilakan et al., 2012). Gelatin is used to wrap vitamin, mineral and drug capsules, and collagen is used in cosmetic products such as face creams. Finally, fish waste can also be used to make biodiesel (Regal Springs, 2021).

All things considered, this sector is characterised by generating a high amount of organic waste. These residues are used mainly for the production of fishmeal and oils, which are used as raw materials for the production of other food by-products. It should be noted that in the fisheries processing sector, waste is increasingly being used for the production of cosmetic and pharmaceutical products. This reflects how the waste generated can be transformed into many different by-products.

### 4.2.3. Dairy Industry

As analysed in the previous section, all companies dedicated to the production of dairy products need to use large amounts of water to carry out a myriad of processes during the production chain. As a result of the dairy industry's dependence on water, companies have been forced to find the most efficient ways to recycle as far as possible all the water that ends up being discharged as an effluent.

This industry generates most of the effluents after the production of different dairy products such as milk, butters, yogurts or cheeses generated. These wastewaters generated during the pasteurisation or homogenisation contain high levels of toxic additives that must be neutralised before being discharged through the sewers or directly into the sea. For these reasons, an effluent treatment must be carried out to treat dairy by-products such as whey and its derivatives (Condorchem, 2013).

These by-products are characterised by generating wastewater containing large amounts of sugars, fats, proteins and some residues resulting from the additives added to these products.

Generally, the treatment of effluents is carried out making use of flotation techniques. This technique consists of separating those substances floating in the polluted water by means of air bubbles. What is more, flocculators are used to increase the effectiveness of the process.

An example of these practices is *Grupo Leche Pascual*. This company treats and purifies its effluents to later reuse the waters obtained for different industrial uses. Once the rest of the waters have been treated, they are returned to the public channel to close the circular cycle.

In the last decade there has been extensive research to look for different effluent applications. For this reason, alternatives have been sought such as the creation of biodigesters for the generation of biogas from effluents.

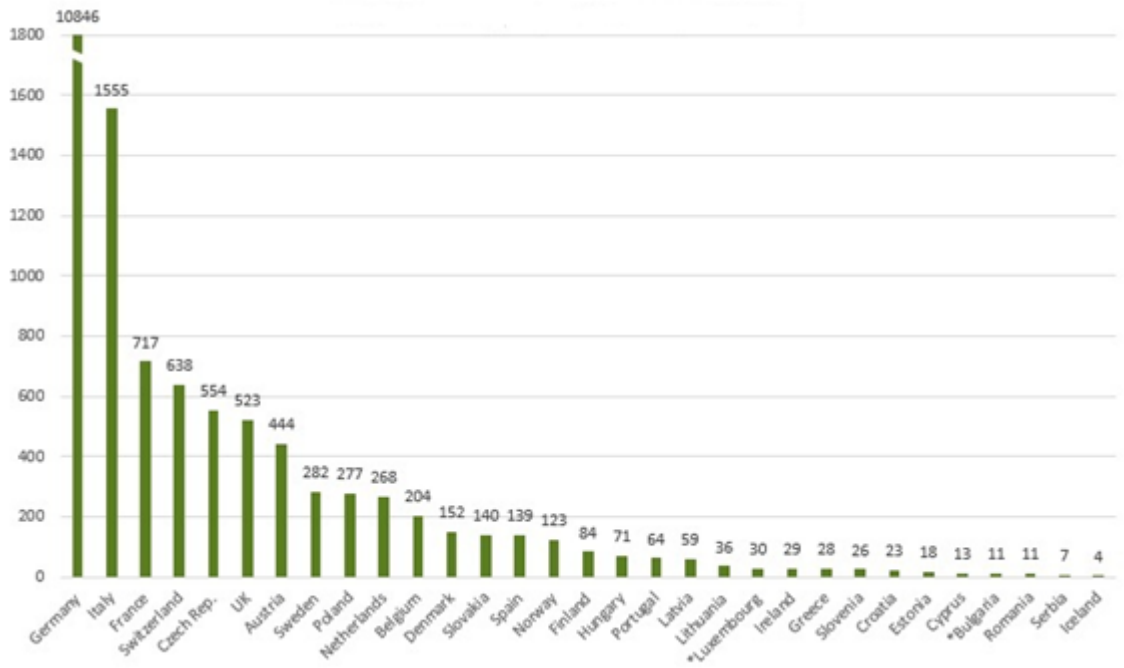
In 2017 the Government of Cantabria and the dairy industries *Quesería Lafuente*, *Andrós la Serna*, *Andía Lácteos*, *Consorcio Español Canning* and *Froxá* were the pioneers in launching a project based on sustainability, proximity and circularity for the production of biogas from the residues of the agri-food industries (Diaz, 2017).

This practice was followed by the dairy manufacturer *Lence* who developed the *Riazor* project. This project has the objective of constructing an innovative circular waste management and a biogas generation plant located in Lugo. This plant will be able to handle up to 55,000 tons of waste per year. In the words of Carmen Lence, president of *Lence*: “The start-up of this plant constitutes a great progress since it will allow us to close a circle by reducing our emissions significantly, minimising our carbon footprint and reusing our waste, which will undoubtedly have positive effects on the environment ” (Llera, 2021).

Despite the good practices carried out, more biogas plants must be constructed by Spanish companies. According to a report by the *European Biogas Association* in Europe there are 18,000 biogas plants in Europe. However, only 139 are located in Spain. According to Francisco Repullo Almagro, president of the *Spanish Biogas Association (AEBIG)*: “If there are no bonus or special rates, the sector is not economically viable, because it did not emerge as just another renewable energy, but as an environmental solution” (El Confidencial, 2019). Hence, there is a need to make both economic and legal modifications to guarantee its viability in the future.

In the following graphic (illustration 6), it can be observed the number of biogas plants of each European country. Spain is in the 14th position, behind Germany who is the first one in the ranking with 10846 biogas plants.

**Illustration 6, Number of biogas plants in European Countries**




***Source: Biomass Magazine (2019)***

Other countries such as French follow a system of incentivising the production based on investment, the power installed or the energy produced. For this reason, as stated by Francisco Repullo Almagro: "If there were incentives, we have an incredible potential, especially because we are leaders in pork, the third largest producer in the world, so we have large quantities and we need to do something with it" (El Confidencial 2019).

Nowadays, the reality is that a biogas plant is a risky business, and it has to be improved to catch up with other European countries (Muradin et al., 2018).

After carrying out the analysis, it can be concluded that the main problem in this sector is the generation of effluents. The most effective practice being conducted to face this problem is the production of biogas by treating effluents. It is a very widespread practice in many European countries even though it is not a common practice in Spain since Spain needs technological improvements. However, companies are starting to focus on the generation of biogas.

### 4.2.4. Bread and Milling Industry

As previously examined, this sector is the one that generates the least quantity of waste, since it is a very clean and environmentally friendly sector. This can be explained as a consequence of the products employed in the sector. The raw materials used are basic and primary and therefore, they have not yet been barely treated or modified which means less waste generation.

Despite the favourable situation in the sector, companies have also investigated and worked to find solutions and try to reduce the waste generated within this industry. One of the most revolutionary results that has been achieved is the creation of completely biodegradable containers to store both bakery and pastry products (Iresiduo, 2017).

This project began in 2010 and has been developed by the *Cereal Technological Centre (CETECE)* of Palencia and the *Association of Plastic Materials AIMPLAS* of Valencia under the slogan of *Bread for Plastic*. Due to its repercussions, in 2017 it was selected as one of the 15 best *LIFE* projects and opted for the *Green Awards*. This European waste treatment and residues evaluation project has been funded by the European Union *LIFE* + program. Important companies in the sector such as *Panrico* and *Grupo Siro* have strongly supported this innovative proposal.

As claimed by Ana Garcinuño Prados, head of R + D + i in *CETECE*: “We seek to obtain a plastic polymer from sliced bread crusts and biscuit remains that could be used in the preservation of these products and thus, close the cycle. The polymer obtained is lactic acid, and thanks to this compound, it has been possible to obtain polylactic acid. Later, polylactic acid is needed to create bags and trays to store bakery and pastry products (Álvarez, 2014).

The containers obtained thanks to polylactic acid have properties which act as a barrier against oxygen and water vapor. These characteristics are suitable for packaging sweets and shortbreads. Moreover, a shelf life of approximately one year can be achieved, that is, a shelf life equal to the one of traditionally used polypropylene containers. In addition, another advantage of this type of packaging is the considerable reduction in products’ rancidity compared to traditional polypropylene packaging.

From *CETECE*, they explain how this innovative system for waste treatment has been developed and they assure that the new packaging for bakery and pastry products reduces waste generation.

Finally, the most beneficial aspect for the environment is the fact that these containers are completely biodegradable and compostable as a consequence of the organic waste materials employed to make them.

Now it is the responsibility of plastics producing companies to decide to include this waste as a raw material. There are already some companies in Germany interested in implementing it, since some companies are currently producing bioplastics from corn or pineapple.

For these reasons, this sector has the highest level of circularity. Furthermore, extensive research has been conducted for years in order to face one of the main problems of the bread and milling industry which is packaging. For this reason, innovative solutions have been achieved, such as packaging made from bakery waste. Despite this, much research is needed since these packages are still being investigated.

### 4.2.5. Beverage Industry

As it has been already mentioned in the previous sections, containers play a key role in the beverage sector since each beverage is stored in a different type of container. Therefore, the main problem that must be addressed within this industry is the management of beverage packaging.

Companies in the beverage sector share a number of strategies to promote the circular economy and environmental sustainability. Currently, the creation of an efficient eco-design container is highly used. This is achieved on the one hand by reducing cans' weight, glass bottles, tetrapack cartons and plastics to use fewer resources and facilitate recycling (Pjuari, 2006). In addition, it is intended to increase the amount of recycled material contained in packaging.

According to Leonor Pascual, from the Department of *Packaging Technologies of the AINIA Food Technology Institute:* "Currently there are three key strategies for the ecodesign of food packaging" (Consumer, 2021). The strategies can be summarised as follows:

- Making a container recyclable or reusable.
- Reducing the amount of material used for its manufacture.
- Manufacturing with alternative components, more sustainable than conventional ones (for example, recycled material or other precedents from renewable sources).

In the present days, almost all the companies selling beverages have already implemented eco-design strategies. Nevertheless, *Coca-Cola* is one of the best examples in the market.

Thus, *Coca-Cola* designs its cans and bottles taking into account the environmental footprint generated by the production and distribution of their products in order to reduce it as much as possible. This is achieved, for example, by diminishing its weight and increasing the percentage of recycled material as well as by innovating to facilitate recycling and developing novel alternatives to traditional packaging.

*Coca-Cola* cans and bottles are now lighter and contain more recycled material. In fact, the weight of the Contour refillable glass bottle, the most iconic of the *Coca-Cola* brand, has been reduced by 21% compared to the year 2000. Additionally, the 2-litre plastic bottle has decreased in weight by 35% since 2010 and now, cans weigh up to 60% less than 30 years ago. In terms of the amount of recycled material, *Coca-Cola*'s plastic bottles currently contain 25% recycled plastic (in 2017 it was 13%) and the goal is to raise that percentage to 50% by 2022 (Morales, 2020).

Another strategy so as to reduce the environmental impact is to improve the containers' characteristics such as changing the colours of removing unnecessary plastics to make it easier to recycle. For instance, the green coloration has been eliminated from the bottles of *Aquabona* with gas, which allows transforming the bottles into new ones. Thus, 99.6% of *Coca-Cola* packaging is completely recyclable. By the same token, at the end of 2019 *Coca-Cola* replaced the plastic wrap of its multipack cans with a 100% recyclable cardboard one (Confilegal, 2021).

A positive aspect is the population is aware of the environmental issues since more and more people practice recycling in their daily routine. For this reason, beverage consumers play a fundamental role in the recycling process.

There are several types of beverages packaging although only four of them are considered the most used. These types of packaging are glass, plastics, steel, aluminium cans, and tetrabrick. Each of them addresses the circular strategy in a different way.

**Glass**

Glass has managed to establish a circular economy model in which recycling is a fundamental part. This is due to the fact that this industry has tried to achieve recycling rates of around 65%, so this percentage reflects how almost two-thirds of the raw material needed to make new packaging comes from recycled glass. However, these numbers are increasing year after year thanks to the awareness of citizens. According to Juan Martín Cano, secretary of the *National Association of Glass Container Manufacturers (ANFEVI)*: "The

circular model of the glass container industry is a clear and good example to be followed due to its commitment to the environment and the infinite lives of this material" (ANFEVI, 2020).

After collecting the glass coming mainly from green igloos and shops, it is cleaned. Glass is treated with a series of chemicals and water in charge of removing any type of dirt or adhering grease. Subsequently, any type of non-glass components are removed, such as plastic elements, papers or any other type of waste.

Once it is completely clean and disinfected, the glass goes through sieves and hammers where it is crushed until the desired size is obtained. The next step would be eliminating metallic remains of the crushed glass using magnets.

Finally, the resulting glass together with 50% limestone sand and sodium hydroxide, is ready to go to the melting process, where it is subjected to temperatures of around 1600 degrees. After these processes, the product obtained has practically identical characteristics as the glass manufactured using natural resources (ANFEVI, 2020).

In addition to this type of recycling, glass is also a material that is reused as a result of its properties and the consolidated system of containers' collection thanks to the commitment of companies and consumers.

The containers of certain brands such as *Mahou* or *Coca-Cola* have agreements with the bars and restaurants to which they supply so that they can collect the empty bottles used by their customers and then, bottles return to the factory. Once they come back to the factories, they are washed and disinfected to be refilled with the drink. Thanks to these types of practices, the average of glass bottles is 35 uses so a bottle can be used on a high number of occasions (El Mundo, 2020).

Different beverage companies have come together in the *Glass Spain Association* to contribute to the creation of an industry that allows this sector to be at the forefront of circular development. The main objective is to adopt innovative and inclusive production models. In this way, it is possible to avoid or at least minimise the extraction of virgin raw materials and the consequent depletion of natural resources.

Glass Spain is made up of companies belonging to *AFELMA (Association of Insulating Mineral Wool Manufacturers)*, *ANFEVI (National Association of Automatic Glass Container Manufacturing Companies)*, *Hollow Glass Manufacturing Association*, *FAVIPLA (National Association of Flat Glass Manufacturers)*, as well as by companies that manufacture glass filaments and tableware *(FAOVI)*. The companies that make up *Glass Spain* represent more than 98% of the total Spanish glass production (ANFEVI, 2016).

Thanks to *Glass Spain*, the glass industry has increased its sales in Spain by 36%, reaching a sales volume of more than four million tons in the last year with a value of over 2,000 million euros. This growth has been triggered by the aforementioned increase in recycled glass. Using more than 50% of the recycled glass instead of virgin glass allows companies to save on many production processes (Ecoticias, 2021).

Glass is fully associated with the concept of circular economy because glass is recycled within the same production system taking into account that a container is created from another container (Berkens et al., 2011). Moreover, the material does not undergo physical nor chemical changes.

**Cans**

This type of container is the one with the highest recycling rate since in Spain approximately 86% of all cans are recycled according to data from the *Beverage Cans Association (ALB)*. According to statistics from the INE, in 2019, 118,000 tons of steel and aluminium beverage cans were recycled in Spain. According to Miguel Aballe Caride, director of the *Beverage Cans Association*, "cans are ideal containers in an environment with a circular idea" (ANFEVI, 2020).

Waste generated by these containers is not only transformed back into cans, but also they end up having a great variety of different uses in the manufacture of metal products. Aluminium cans, like all recycled objects made of this material, are converted into large aluminium coils that end up being distributed and reused again in cans or in any type of product that needs this material.

One of the most important benefits of this material is that it can be used unlimited times after being recycled. Aluminium is characterised by maintaining its innate properties of resistance, hardness, corrosion, ductility or electrical conductivity. In addition, recycling cans reduces the use of energy (Every Can Counts, 2015). This is because the aluminium made from scrap metal processing consumes 95% less energy than making aluminium for the first time.

Taking into account that Spain is the second country in the ranking of can consumers after the USA, the fact that cans can be used infinite times is relevant for the Spanish companies. Furthermore, in the last ten years the consumption of cans has doubled because cans are more comfortable to transport. Besides, Spanish citizens usually drink cold drinks and cans give the drink a freshness sensation (Infopack, 2018).

Thanks to the good recycling results being obtained in recent years, the objective is to reach a recycling rate of 100% since cans are going to increase their use considerably in the coming years. For all these reasons, aluminium packaging belongs to the idea of circular economy (Asociación Latas de Bebidas, 2020).

The advantages of can packaging encourage companies to use cans. This is the case of the *Glass* wine company located in Barcelona, which has begun to distribute wines in 100% recycled and recyclable aluminium cans. This type of packaging generates a tiny environmental footprint and considerably reduces production costs compared to glass bottles (The New Barcelona Post, 2021).

Glass is not the only company that has had this initiative since other companies such as *Flava*, a Madrid start-up of low alcoholic beverages, has launched a new product. It is Hard Seltzer, a type of beverage highly demanded in the US characterised by having a very low caloric intake and an alcohol content of around 5%. The peculiarity of this product is that it is marketed in a format of completely recycled cans and the main consumers are the youngest who are increasingly looking for alternatives to beer and wine. The firm's team is preparing to launch an ambitious marketing campaign to present *Flava*. In addition, Flava is forward-looking and will not focus exclusively on the production of Hard Seltzer, but also on the innovation and creation of new canned beverages for the Spanish market.

In the words of Ricardo de Zulueta, one of the founders of *Flava*: “We know that the market demands products with fewer calories and sugars, as well as a lower alcohol content. There are interesting opportunities reinventing some of the Spanish classics such as tinto de verano or sangria by changing the packaging and reducing calories, sugars and alcohol” (Financial Food, 2021). They also consider the idea of marketing canned cocktails, such as gin and tonic, a trend in the US and Northern Europe, a business opportunity that is not currently covered in the Spanish market.

On the other hand, it is worth mentioning that the *Estrella Damm* factory in Barcelona has been the first beverage company in the world to receive the *Aluminium Stewardship Initiative (ASI)* certification, which guarantees responsible aluminium production, supply and management.

Every year there are numerous campaigns such as the so-called *Every Can Counts* promoted by the *Beverage Cans Association* present in 12 countries. The initiative aims to sensitise citizens about the importance and need to deposit the cans in the yellow container (Asociación Latas de Bebidas, 2020).

**Tetrabrik**

Tetrabriks are rectangular-shaped containers that appeared on the market around the 60s and that usually store beverages such as milk, juices, wines, broths to name a few. These containers are the worst ones since a priori it seems that they are made exclusively of cardboard. However, the reality is completely different, although 75% of its total composition is cardboard, it is also composed of 5% aluminium and 20% polyethylene, which is a plastic by-product.

Although tetrabriks generate a negative impact on the environment, they have succeeded in the market because of its characteristics such as lightness, ease of storage and transport or their simple opening. However, tetrabriks contain materials which are complicated to recycle. In order to recycle a tetrabrik, a correct separation of the materials must be carried out and each of the materials will have to undergo a different type of recycling process.

In order to separate the materials, it is necessary to use pools with water where the waste is exposed to high temperatures (around 500 degrees). Thanks to this process, the existing polyethylene sheets can be separated from the aluminium and they are melted and transformed into gas (Bayer, 2002).

In Spain, this recycling process cannot be carried out completely since today there is not any plant in the country with the necessary technology to recover aluminium and plastic. One of the main factors to explain this fact is the economic factor since the state does not subsidise this type of project and it is hard for companies to assume these costs. For this reason, most companies only recover the cardboard and they discard the part where the aluminium and polyethylene are to landfills.

However, a decade ago a recycling method for these containers was developed. In Barcelona, the plant Clean Palwaste Recycling, a subsidiary company of the Scandinavian paper group *Stora Enso*, was inaugurated. It was the first company in Spain to develop a project to reuse all the tetrabriks' materials thanks to high money investments in R + D + i. According to Juan Vila, CEO of the factory, the company invested 7 million euros in a project to extract aluminium and polyethylene from tetrabriks. The plant received numerous international recognitions, including the award *The Best of the Best* from the Life-Environment Program of the European Parliament. Moreover, the project has been endorsed by the CDTI, the European Commission and the Ministry of Industry of Spain (Residuos Profesional, 2020).

The plant received the tetrabrik containers from cities throughout the Spanish geography and from other countries such as France, Portugal, Belgium and the United Kingdom. The plant has the capacity to process up to 30,000 tons per year. These containers are recycled with a technology which allows the recovery of 100% of the tetrabriks' materials.

In this way, the plant of *StoraEnso* Palwaste Recycling achieved the full recovery of all materials used in tetrabrik packaging, including cardboard fibre, plastic and aluminium.

Nevertheless, this project required a large investment and finally, the recycling plant was closed because it was not profitable. Nowadays, the containers processed by this plant are transported to a company dedicated to recycling paper in Zaragoza. According to its figures, the company treats 50,000 tons per year although around 30% ends up in the landfill. Hence, institutions and government support is needed to carry out this type of project (Residuos Profesional, 2020).

The companies which produce this type of packaging are being pressured by environmental associations such as *Greenpeace*, *Ecologists in Action* and *Friends of the Earth* among others. These associations demand replacing tetrabriks by single-material containers easier to recycle. An example of the associations' pressure and the increasing awareness of the population is that leading companies in the dairy sector such as *Pascual* are changing their packaging. In the case of *Pascual*, they have developed a new container called *Tetra Brik Aseptic Bio-based* with 89% renewable materials such as sugar cane and FSC cardboard. The brand manages to convey a sustainability image and at the same time, the company reduces its environmental impact. As Víctor Córdoba, general director of the Pascual Quality Dairy Business Unit, states: "Caring for the environment is one of our pillars, that is why we want our packaging to have the least impact on the planet we live on" (Villaécija, 2020).

As a consequence of the measures proposed by green associations, some European companies are offering single-material containers as an alternative to the conventional tetrabrik`s. This is the case of the well-known Finnish dairy brand *Arla Oy*, which has introduced a packaging that employs bioplastic derived from wood for its milk products. In this way, the inner layers of polyethylene and aluminum plastic that are present in the tetrabriks are replaced. *Arla*'s new monomaterial containers use an inner layer of bioplastic obtained from the "talloil". "Talloil" is a waste generated in the production of paper so it does not require cutting down trees (Naider, 2019).

Apart from recycling, the best alternative to reverse this situation is trying to use other types of packaging less complex to recycle.

**Plastic**

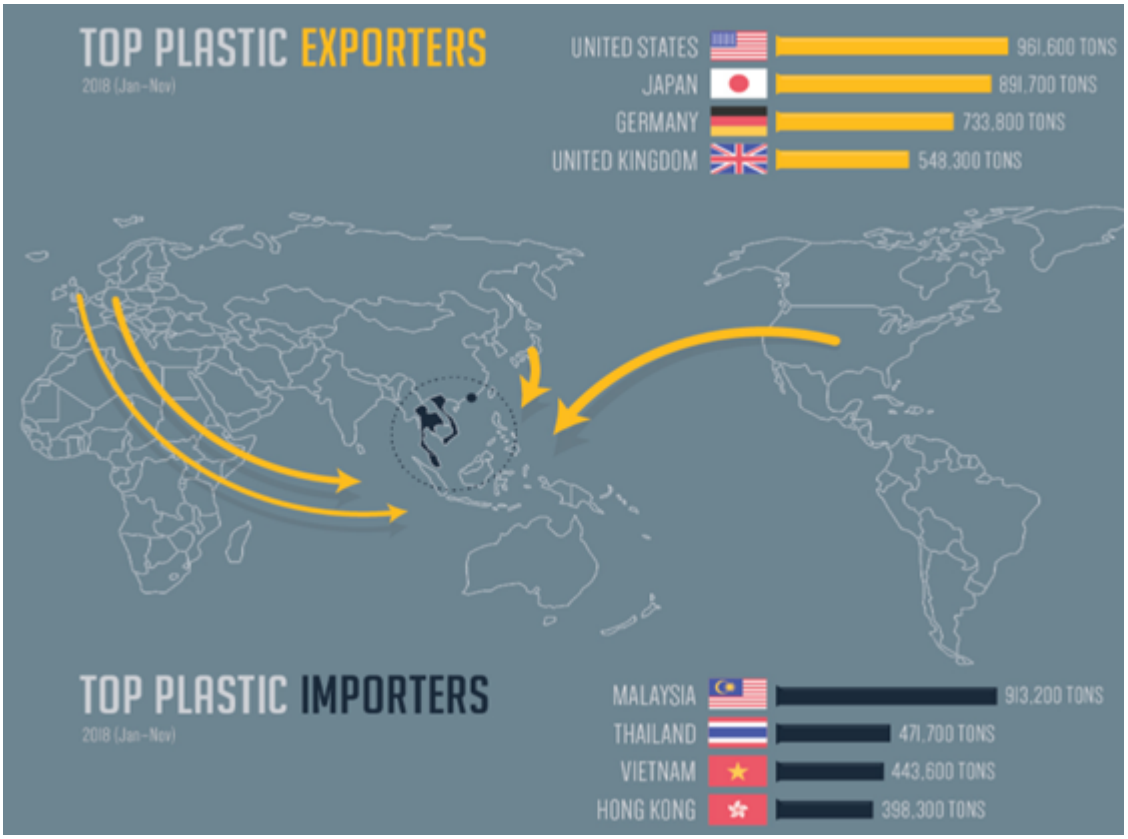
Plastic bottles can last in the environment for more than 500 years because their materials take a long time to biodegrade. In addition, plastic contaminates the environment during its life.

Currently, one of the most common practices is waste exportation. This practice is conducted by countries such as the US (961,563 tons), Japan (891,719 tons), Germany (733,756 tons) and Spain (223,000 tons). These companies are in charge of looking for countries allowing the entry of their waste. In other words, plastics are exported to poorer or less developed countries so that they can take charge of their recycling process. This practice is triggering the massive accumulation of plastic in some countries, especially on the Asian continent. Last May, 2020 Malaysia, one of the countries where more plastic was exported, said that it did not want to receive more plastic containers because the exporting countries did not comply with the international agreement on recycling. Malaysia returned plastic containers to their countries of origin. Malaysia gave back 5 containers to the port of Barcelona (De La Cal, 2019).

China was the first country to adopt restrictive measures to curb the import of plastic. In 2018, this country banned the import of plastic waste because 85% of all exported plastic was destined for China. Therefore, European companies looked for other alternatives such as Taiwan, Vietnam and Turkey.

In 2018, after the Chinese government's decision to stop importing plastic waste, the importing countries changed and it can be shown in the image (illustration 7).

**Illustration 7, Top Plastic Exporters**




**Source: Visual Capitalist, from Iman Ghosh (2019)**

However, these underdeveloped countries also closed their borders to European plastic and few countries are willing to accept plastic.

Plastic bottles can also be recycled once they have been deposited in their corresponding yellow container. These are sent to recycling plants where they are processed and they are given another useful life. Once the plastic bottles have arrived at the recycling plants, they are pressed and grouped into rectangular blocks so that they can be handled easily and take up much less storage space (Ghosh, 2019).

After pressing, the bottles are subjected to a rigorous washing process where high amounts of water and detergent are utilised. Once the bottles are clean, any type of label is eliminated since labels are polluting materials.

After these previous processes, the bottles are already dried and classified, and depending on their plastic composition they are recycled in alternative ways. There are five main groups of plastic which are PET, PVC, PE, ABS, and other types of plastics. Although each one has different uses due to its composition, the most widely used for plastic beverage bottles is

PET. Those bottles which are already prepared for recycling are crushed into a kind of small plastic shavings.

After this process, these shavings are washed and dried again to be sold or used in the same plant to make new bottles with recycled plastic.

Most companies in the beverage sector are already integrating recycled PET (rPET) into their packaging. *Font Vella* brand markets all its bottle formats with 100% recycled plastic (rPET). Likewise, *Pascual* brand claims that by the end of 2021 all *Bezoya* bottles will be made of rPET plastic. Other companies such as *PepsiCo*, owner of *Pepsi-Cola*, *Kas*, *7Up* and *Gatorade* brands are already manufacturing all 2-litre bottles with 50% rPET. Moreover, *AUARA* is a company that performs superb environmental practices. It is a mineral water distribution company that manufactures all its bottles with 100% recycled plastic, giving a second life to 277,000 Kg of plastic per year.

Every year more companies innovate in recycling and bioplastic technologies. This year *Coca-Cola* has presented the first bottle made from plastics recovered from the seabed and beaches of Spain and Portugal. This initiative has been carried out by the companies *Ionica Technologies* (a plastic processing company) and *Indorama Ventures* (a company that has manufactured the bottles) together with the *Circular Mares* project. It is an ambitious project in order to clean the coasts and seabeds. The bottles manufactured are made of 25% of this plastic, however *Coca-Cola* has set a goal for 2022. *Coca-Cola* will include 50% PET plastic collected in the seas in its bottles until gradually reaching 100% in a short period of time (El Mundo, 2020).

Companies using plastics to package their products must adopt the measures implemented by the European Union. This is due to the fact that the European circular economy strategy has a medium-term objective. Before 2030 all manufactured packaging will be made of 100% recyclable plastic. This initiative promotes that by 2025 all plastic containers will contain at least 25% of this plastic and 30% from 2030. In addition, the pressure exerted by consumers is increasing and they demand sustainable solutions and a reduction of the use of plastics for packaging. For this reason, companies must introduce changes to meet consumers' demand (Infopack, 2021).

This pressure has led to new business models aimed at reducing the generation of packaging. These are use-by-service models instead of the traditional purchasing model. One of the most representative companies is *Aquaservice*. This company is responsible for distributing returnable 20-litre bottles that can be reused 50 times. These bottles are not sold, so when their useful life is over, it is guaranteed 100% recycling of the bottle. In this

way, the company allows consumers to access bottled water by avoiding disposable containers. In addition, *Aquaservice* complements its water dispenser service with mini half-litre bottles. To guarantee their recycling, they are going to launch a new product, the Minibox, a box that collects all the empty PET bottles. After using the bottles, the customer deposits them in the Minibox and the delivery person will collect the bottles to recycle them (Gutiérrez, 2020).

**Table 3. Strategies adopted by the food and beverage sub-sectors**

| SECTOR | CIRCULAR PROCESSES IMPLANTED | EXAMPLES |
|---|---|---|
| **Meat industry** | -Effluent treatment<br>-Biogas production from effluent residues<br>-Organic waste treatment for the production of animal feed<br>-Slurry treatment for the production of fertilisers and composting | ***El Pozo*,**<br>***Subcarn*** |
| **Fisheries Processing Industry** | -Manufacture of fishmeal and fish oils from their waste<br>-Preparation of feed from fish by-products<br>-Manufacture of pharmaceuticals, cosmetics and fuel | ***Jealsa Rianxeira,***<br>***Aucosa*** |
| **Dairy Industry** | -Effluent treatment<br>-Production of biogas from effluent residues | ***Central Lechera Asturiana,***<br>***Grupo Leche Pascual*** |
| **Bread and Milling Industry** | -Manufacture of biodegradable packaging with food waste such as bread or flour | ***Grupo Bimbo*** |
| **Beverage Industry** | -Efficient eco-packaging design<br>-Increase the amount of recycled material contained in packaging<br>-Manufacture with alternative components more sustainable than conventional ones | ***Grupo Mahou-San Miguel,***<br>***Coca-Cola*** |

***Source: Own Elaboration***

After analysing the beverage sector, it can be said that it is the one that has the greatest impact on our society. This is due to the large amount of waste, mainly packaging that citizens consume on a daily basis. As a consequence, the companies of this sector have been forced to take a series of measures with the purpose of reversing the current situation. These measures are based on eco-designs and give packaging a second life to establish the model of manufacturing in which a container is reused instead of discarded.

## 4.3. Examples of Good Practices of Companies Implementing Circular Economy Strategies

The circular economy model has led to changes in the existing business and has fostered the creation of new business models. Therefore, five examples of successful strategies related to the adaptation to circular economy have been explored in this section. These cases, which belong to different sub-sectors of the food and beverage Spanish industry, have been selected because of their alignment with the principles of the circular economy. Our intention is that they can serve as examples to encourage other companies to change towards a more circular economy model since it brings a large number of benefits not only for the companies itselves, but also for the whole society.

### 4.3.1. Practices of El Pozo Company in the Meat Sub-sector

The example that we are going to deal with within the meat industry is the company El Pozo Alimentación. This company has set as its main objectives to base its growth on the principles of the circular economy. To do this, El Pozo has incorporated a series of initiatives based on three axes: reappraisal of products throughout their life cycle, reduction of their environmental footprint and energy efficiency to become a reference for environmental responsibility. (El Economista, 2020).

*El Pozo* was the first company in the meat sector to obtain the ECOSENSE certificate, which guarantees the recovery, recycling and incorporation of plastic material generated into the process. The company seeks to include a high percentage of recycled material in its packaging through the eco-design in the medium term and promotes the use of sustainable products.

Another important aspect is its reappraisal project which has the objective of Zero Waste (El Pozo, 2016). This alternative is carried out thanks to the systems installed in its factories that

allow classifying, quantifying and separating all the waste generated within its facilities. For this reason, almost 100% of all the waste generated in the different production processes is revalued and therefore reused.

To promote a more sustainable environmental management, El Pozo and Cefusa, its principal meat supplier, have started to reappraise the meat waste generated. The meat waste generated by El Pozo after processing its products is used as raw material to produce animal feed.

Furthermore, El Pozo has also optimised the use of water. This is an important point as water is a limited resource in Murcia where the company is located. To achieve this goal, the company has invested in developing a complete purification process which allows the total treatment of the effluents generated. As a result, 100% of its treated water is used for the irrigation of more than 400 hectares of crops. Moreover, the company has reduced water consumption by 10% throughout its production process. Furthermore, El Pozo has invested more than 3.5 million euros in a biogas plant. In this way, the company is able to obtain energy from the anaerobic digestion of the remaining waste originated after treating its effluents. As a result, the company has been able to significantly reduce the use of fossil fuels. The biogas produced is also used for the production of heat needed in different production processes, such as the sewage treatment plants.

Reducing the environmental footprint is one of the main challenges for *El Pozo Alimentación* (La Verdad, 2020). The company has launched a recycling project called *Sustainable Work Centre* in order to carry out a collection of domestic waste. The main objective of this action is to encourage among the 5000 workers of the company the acquisition of a correct recycling culture through the recovery of paper-cardboard, plastic, cans and tetrabriks. This initiative includes the installation of selective collection points for different types of packaging in common areas such as cafeterias, rest areas and offices.

This project has been carried out thanks to the collaboration of *Ecoembes*, the environmental organisation in charge of coordinating the recycling of packaging throughout Spain. *Ecoembes* has provided the company with 50 recycling containers. The council of Alhama, Murcia has also collaborated with the municipal waste collection company FCC with its logistics services.

In addition, *El Pozo* also has a photovoltaic installation that allows the production of renewable energy, which has led to a 54% decrease in lighting.

After analysing the strategy carried out by El Pozo, we can conclude that the company is trying to adapt to a circular economy mainly focusing on energy and waste reduction.

### 4.3.2. Practices of Jealsa Rianxeira Group in the Fisheries Sector

The company analysed in the fisheries processing industry is *Jealsa Rianxeira group*. This group is made up of a total of 26 companies and is ranked first in terms of sales compared to Spanish fisheries companies. *Jealsa Rianxeira* had a turnover of 701 million euros in 2020 (El Correo Gallego, 2021).

At present, all the companies in the group assure that they are carrying out a completely circular economy considering that they fully exploit its raw material. In 2020 they created the *Corporate Social Responsibility (CSR)* program called *We Sea*. As stated by Ángeles Claro, director of the program "It is a question of responsibility to seek the maximum use of all the parts of the fish that are not destined for canning" (Jealsa, 2021). They have implemented a revaluation ecosystem where different companies receive raw materials that are transformed into high-quality products for different industries such as aquaculture, animal feed or functional ingredients.

The main line of action of *We Sea* is the circular economy system implemented by *Jealsa*. For this reason, most of the R + D + i investments are destined to the transformation phase and packaging of raw materials because at this stage most of the waste is generated (Interempresas, 2021). It is for this reason that the *Jealsa* group has numerous collaborations with different national and European organisations which test the effectiveness and viability of the implemented circular economy system. The main collaborating institution is the Higher Council for Scientific Research (CSIC) operating through the Vigo Research Institute (IIM-CSIC) (Jealsa, 2021).

On the other hand, the Centre for Industrial Technological Development (CDTI) is supporting this project through aid co-financed by the European Regional Development Fund (FERER), through a *Smart Growth Program*.

Under the assumption of exploiting all its raw material, the company makes the following distribution of raw materials and waste:

- 40% is used for the manufacture of products intended for human consumption under some brands such as *Escurís* or *Rianxeira*.

- 5% is employed to prepare pet food through the *Pet Select company*, which processes fish waste for the production of different animal food products.

- 35% is destined to the elaboration of fishmeal and oils

- The remaining 20% is allocated to new reappraisal processes. These processes are carried out by the company *Valora Marine Ingredients,* a member of the Jealsa group, which uses certain waste as raw materials to create products for the pharmaceutical and cosmetic industries.

*Jealsa* and *Valora Marine Ingredients* have collaborated with the recycling and *Waste Recovery (REVAL)* and *Food Biochemistry* groups since 2018. Both belong to the Vigo Research Institute since they seek solutions to give a second use to the products and effluents generated in its processing plants.

As Xosé Antón Vazquez, director of the *REVAL* group assures: "This collaboration represents an excellent opportunity to improve the productive performance of the fish canning industry" (Jealsa, 2021). In this sense, we can conclude that *Jealsa* is a company which is trying to do the circular transition through R+D activities.

### 4.3.3. Practices of Central Lechera Asturiana in the dairy sector

The example of the dairy sector that will be examined is *Central Lechera Asturiana (CLA)*. Due to its commitment to the environment and its zero-waste circular economy strategy, this company has been the first company in the dairy sector to obtain the *AENOR* certification in all its factories (Eactivate, 2020). This certificate has been obtained thanks to the implementation of the *Comprehensive Sustainability Plan* developed to achieve neutrality in the entire production process by 2035. At the end of 2020, the company invested around 20 million euros to improve the production of the factories to reduce the negative impact on the environment.

*Central Lechera Asturiana* has created different projects based on green and energy saving strategies. The company has achieved the *Forest Steawardship Council (FSC)* certificate, doing that 98% of the drink containers come from recyclable plastics (Compromisorse, 2020). Additionally, the cardboard used for its packaging processes comes from 95% recycled sources. Besides, the company has reduced water consumption by 15% and has developed a series of waste conversion initiatives for the production of biogas and biofertilisers with the objective of improving soil health.

*Central Lechera Asturiana (CLA)* made a strong commitment to the circular economy in February 2020. The company acquired 84% of the *Biogastur* company (the company already had 25% of *Biogastur* since the year of its foundation), an energy production plant from livestock slurry. The main purpose of this initiative was to relaunch a factory that was practically idle following the zero emissions policy. *Biogastur* is prepared to process 1000 tons per day of slurry. Later, slurry generates methane to be employed as gas or it is transformed into electricity (Central Lechera Asturiana, 2020).

The aim of the *Biogastur* company is to transform the gas obtained after burning the methane and transform it into biomethane to be directly injected into the gas pipeline Moreover, it can be used as fuel for the company's vehicles. This plan involves an investment of 2.5 million euros. On the other hand, thanks to Biogastur, CLA generates more than 99% of the energy needed for any dairy process.Thus, it avoids the emission of 11,000 tons of CO2 per year into the atmosphere (Central Lechera Asturiana, 2020).

It can be concluded that CLA focuses its practices on actions related to the elaboration of biogas in order to reappraise the effluents generated.

### 4.3.4. Practices of Bimbo in the bread and milling sector

The example examined in this sector is *Grupo Bimbo*, a company that has made a firm commitment to the reduction of plastics and packaging before the year 2025. As a result of this commitment, *Grupo Bimbo* will reinforce its global strategy in waste management (Grupo Bimbo, 2021). The main strategies will be:

- Fostering the design and innovation to reduce the use of plastic and implementing solutions related to recyclable materials.
- The company wants to guarantee that by 2025 that 100% of the packaging used by *Grupo Bimbo* will be made of recyclable material (at present, it is 80%).
- Identifying and eliminating the plastics excess within their manufacturing processes.
- Ensuring the supply of certified sustainable packaging sources, both paper and cardboard.
- Carrying out practices helped by its suppliers in order to reuse and recycle secondary packaging and all post-industrial waste.

- Promoting and participating in post-industrial and post-consumer recycling alliances including consumers' communication and the development of infrastructure so as to handle materials.

As previously analysed, the bread and milling sector hardly generates waste. For this reason, companies focus on packaging when they try to advance towards circular transformation.

Therefore, *Bimbo* has undertaken the initiative of incorporating oxo-biodegradable technology in packaging. This is a way of reducing the packaging that is not disposed of properly. Thanks to this new technology, plastic is converted into CO2 and biomass.

Another interesting practice carried out by the company deals with its product waste. To eliminate it, they have opened cooperations with companies such as *Olisefi* (Expansión, 2020). This company transforms around 180,000 tons of bakery waste per year into an ingredient for the production of animal feed. In this way, *Bimbo* ensures that its production process has little impact on the environment since the waste generated serves as raw material for other companies instead of being discarded.

After examining the practices carried out by Bimbo, it can be said that Bimbo focuses its efforts on aspects dealing with products´ packaging and the revalue of food waste.

### 4.3.5. Practices of Mahou-San Miguel group in the beverages sector

*Mahou San Miguel* group, one of the most popular beer brands in Spain, is analysed in this section. This brewing group comprises different brands, both *Mahou* and *San Miguel*, as well as *Alhambra*. The following table (table 4) shows how the most consumed beers in Spain at the hectolitres (HL) level per year belong to *Mahou San Miguel*. Therefore, we can assume that any practice they implement will have the greatest impact on the market. In this sense, this company can be considered as a booster in this sub-sector.

**Table 4. Main beer groups in Spain**

| Ranking | Brewing group | Hl / per year (milions) |
|---|---|---|
| 1 | Mahou San Miguel<br>(Mahou, San Miguel, Alhambra...) | 12,73 |
| 2 | Damm<br>(Cervezas Damm...) | 10,59 |
| 3 | Heineken España<br>(Cruzcampo, Amstel, Heineken, El Águila, Buckler...) | 10,49 |
| 4 | Hijos de Rivera<br>(Estrella Galicia, 1906...) | 3,47 |
| 5 | Compañía Cervecera de Canarias<br>(Tropical, Dorada...) | 1,09 |
| 6 | Agora<br>(Ambar...) | 0,98 |
| 7 | Otros | 0,17 |

***Source: Ranking brewing groups. Source: Cerveceros de España (2020)***

*Mahou San Miguel* group has been one of the first companies to establish a strategic sustainability plan to promote the circular economy and to achieve a series of objectives by the year 2025.

One of the most interesting objectives pursued by the company is to reduce packaging materials. To do that, they are promoting returnable packaging formats. Regarding the glass containers, which is one of the most important points in this sub-sector, they are made of

100% recyclable glass. This is possible thanks to the collaboration of all the parties involved in the glass and bottles manufacturing process.

Efforts are made to achieve that 80% of the total volume of sales with glass containers will be returnable to be able to reuse them (Mahou-San Miguel, 2021). In order to accomplish this objective, the group has created a high number of agreements with its beverage distributors such as bars and restaurants. The deal consists of returning all the glass bottles already used so that they can later be reused in the company's plants. The collaboration of intermediaries is achieved thanks to the application of discounts in subsequent orders based on the bottles that have been returned. Therefore, it is extremely beneficial for both parties.

Another advance has been made in the production of glass bottles. On the one hand, the recycled bottles are subjected to smelting processes to make new bottles and at the same time, the containers are lightened so that less glass is necessary for the manufacture of each container. This is translated into a saving of 3,500 tons of glass (Aral,2019).

In relation to cans, the group manufactures all the cans made of 100% recycled aluminium. Consequently, the raw material used to make the cans comes entirely from other recycled cans.

Besides that, traditional packaging is being transformed into a more sustainable one thanks to eco-design. The eco-design practices developed by the company contributes to the creation of a more circular and sustainable packaging paradigm. These practices mainly involve the reduction of  the amount of material used and the increase of recycled materials.

Furthermore, the company is trying to change, through a marketing strategy, its sales product mix towards those containers that generate less waste. An example of this is that 50% of the total sales made by the company are in barrel format. This means that the generation of single-use containers is considerably reduced.

*Mahou San Miguel* group not only produces beer, but also distributes water from the *Solán de Cabras* brand. In this case, the containers sold under this brand are made of glass and plastic. As regards the plastic used, the company ensures that 50% of the brand's plastic bottles are made of recycled PET. This initiative aims to manufacture the bottles with 100% recycled PET. In order to achieve the target goal, last September 2020, there was a massive campaign regarding the circular economy. At the same time, they launched the first bottle 100% made of recyclable PET, maintaining its iconic format with a unique design.

This campaign was carried out under the slogan *Our bottles are made 100% from other bottles*. This new bottle format would bring a reduction in the use of 1,100 tons of virgin plastic (Navas, 2020).

What is more, during the last 10 years the company has managed to reduce the use of plastics and cardboard for the packaging of its products by 960 and 1000 tons respectively. *Mahou San Miguel* employs different materials for the manufacture of beverage containers such as cans, glass bottles and plastic bottles and a high-quality packaging management is done. The competent management and the adoption of new practices will allow the company to establish a 100% circular economy model in a short period of time (Mahou-San Miguel, 2021).

After analysing the strategies implemented by the Mahou-San Miguel, it can be concluded that this company aims at reducing the materials employed in the packaging through eco-design. Besides, each time the company manufactures a higher percentage of containers made from recycled plastics, aluminium, and glass.

## 5. CONCLUSION

The need to change the current established linear economy paradigm and the increase of the population awareness has led to change the actual production model towards a circular economy model. The main idea is to achieve sustainable development in which the depletion of the natural resources on our planet can be prevented. The foundations of the circular economy can reverse the actual situation (Ellen MacArthur Foundation, 2015). However, this change must be implemented correctly to achieve positive results in the future.

The food and beverage sector, which has been the object of study in this paper, has a great impact on the economic framework of Spain. This is mainly due to the importance of this sector within the country's economy since it represents 22% of the total Spanish industry.

The main objective of this research is showing how the new circular economy paradigm has been accepted satisfactorily in the food and beverage sector given that the number of companies implementing measures related to this economic model are increasing. In this regard, it can be observed not only how business models already being established are adapted to new times, but also how new business models emerge thanks to the circular economy. This shows that good practices of the circular economy bring financial prosperity.

Thanks to the exhaustive analysis carried out in the food and beverage sector, it can be concluded that circular economy is a suitable and sustainable alternative to the linear model, which generates unsustainable production and generates a high amount of waste. To reverse this situation towards a circular economic model, it is necessary to implement a series of strategies within the food and beverage sector. The strategies can be summarised:

1. Management of water, energy and organic matter in order to reuse it as well as the substitution of fossil fuels.

2. Cleaner food production through practices such as feeding livestock with their own organic products or with by-products from other food industries. Reducing the resources in food production and regarding the product logistics, applying eco-design or implementing production cycles self-sufficient in aquaculture.

3. Packaging eco-design and packaging products optimisation which leads to diminish the use of materials and decrease the environmental footprint.

4. Development of new food products for other sectors through the use of by-products.

5. Encourage the collaborative economy through the resale of equipment and goods to other companies in the sector and the sharing of resources.

6. Prevention of food losses and waste throughout the entire food and beverage chain. The trend towards zero waste by promoting the prevention, reduction, reuse and recycling of materials.

Among all the strategies analysed above, some have more impact than the others and they also reach a different level of implementation depending on the target scope of action. It is the case of the strategies related to the eco-design of packaging within the beverage section. The most suitable alternative to reverse this situation would be using other types of containers less complex to recycle compared to conventional ones but carrying out the same function. Moreover, another important aspect could be employing more recycled materials to produce new containers.

On the other hand, there are aspects such as effluents treatment that have been one of the main focuses. As a consequence, a myriad of circular strategies created by the companies have been directly centred on this issue. Effluents are a problem for companies in the food and beverage sector, especially in the meat and dairy sectors. For this reason, much research has been done on the strategies that companies can implement to achieve their correct treatment.

It is worth mentioning that feed for both livestock and aquaculture can be made with materials obtained from food waste from different sub-sectors such as the meat and fisheries sector. This is one of the practices that best reflects the circular economy. In this way, the circular cycle is completely closed.

Although there are common strategies in the different sub-sectors, each sub-sector adopts particular practices because they generate different waste.

-The meat and dairy sectors focus on the treatment of effluents to produce biogas and fertilisers. However, the meat sector also generates organic waste which is used for the production of animal feed.

-On the other hand, the fisheries sector generates mostly organic waste which is highly usable for the production of different products such as fishmeal and fish oils.

-We can conclude that the bread and milling industry is the most sustainable sub-sector since they generate hardly any waste. Therefore, bread and milling companies focus their strategies on packaging. Finally, the beverage sector also implements strategies dealing with

packaging because they are a crucial problem within this sector. These strategies are aimed at reducing the glass, plastic, cans, tetrabriks used in the packaging.

The study has also served to find some circular economy weaknesses in the food and beverage sector. Particularly, this can be reflected in the packaging section since today there are certain containers such as tetrabricks that cannot be completely recycled in Spain due to its components. For these reasons, innovation plays an important role and thanks to investment in R + D + i, companies can develop new initiatives to promote the circular economy.

After conducting this study, it has been found that the circular economy is experiencing a significant increase in the food and beverage sector. This is partly due to the pressure that environmental institutions and associations are exerting so as to establish this economic model. Therefore, more and more companies consider extremely necessary the implementation of strategies and actions with the aim of promoting the circular economy. However, after the analysis carried out, it can be seen that this is a slow process. That is, despite the good predisposition that companies have, it is not easy for them to implement changes due to the production habits that have already been established for years within the sector. For this reason, there is a need to continue advancing so as to redesign the value of the production chains and productive processes within this industry in order to increase the presence of the circular economy.

In order to promote this change, companies should direct their production towards a more sustainable one. Moreover, all the factors involved need to be taken into account until the final product is generated. This can only be possible through the implementation of different measures.

The first measure is the regulation and optimisation of production processes to guarantee sustainability from the beginning of the creation of a product or service. Secondly, companies should carry out an analysis so as to integrate all the life cycles of the products in the market. Promoting reusing them and reducing the generation of waste. Another measure is designing technologies that allow treating and reusing the waste generated at any point in the production process. Finally, another important measure is to provide companies which implement circular economy practices with great incentives. In this way, companies will be more focused on introducing these kinds of measures.

One aspect that reflects the shift towards the circular economy is through the examples of the companies analysed and the measures they are adopting. Representative companies, from completely different sectors are introducing a great number of changes because the

economic model brings benefits. Regarding the meat industry and the dairy industry, El Pozo has invested money to construct a biogas plant to generate biogas from liquid effluents and Central Lechera Asturiana has bought the company Biogastur to treat its liquid effluents. In relation to the fisheries processing industry, Jealsa Rianxeira uses the organic waste generated to produce products such as animal feed, fishmeal and oils. As regards the bread and milling industry, Bimbo has implemented the strategy of incorporating oxo-biodegradable technology in packaging. Finally, in the beverage industry, Mahou San Miguel group is promoting the use of returnable packaging. Moreover, this company is reducing the materials (glass, plastic and aluminium) used to manufacture its containers and is introducing recycled materials in its containers through the eco-design.

These types of companies are the ones which promote the transition towards a circular economy since they can be the source of inspiration for the rest of businesses and companies. In this sense, companies can make a transition from the linear model towards the circular model implementing good circular economy examples in their business models.

Finally, a key aspect for definitively establishing the circular economy is to demonstrate to society the benefits that the implementation of a circular economy model can bring which in turn, will make the population aware of the negative aspects of the linear economy. This change cannot be possible without the commitment of companies and citizens since they are the ones who can reverse the situation. Moreover, institutions play a key role in creating conditions for a circular economy to develop and thrive since institutions are the drivers of innovation and investment. Institutions and governments can establish measures to promote the transition towards the circular economy.

In this way, if society is fully committed to the environment, the best circular practices could be implemented and introduced into the business models in order to promote sustainable economic growth.

To sum up, the circular economy provides a great opportunity to favourably change the food and beverage sector. For this reason, it is vitally important to conduct more research on this economic paradigm so that its full implementation may become a reality in the future. We must be aware that this will be a long process in which the results will not be appreciated immediately. However, if the food and beverage companies and society are committed to the environment, the target objective of implementing the circular economy will be achieved in the medium-term future. In the words of Overmire (2009): “We are the last generation with a real opportunity to save the world”.

To finish this section, regarding the limitations of the study, more detailed research should be carried out. Indeed, this work has been carried out mainly with secondary sources. In relation to future research, we propose to do different interviews to different key actors of the 5 different sub-sectors comprising the food and beverage sector. Doing this, we will be able to understand how challenging and difficult it is to really promote the circular economy in this important sector.

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